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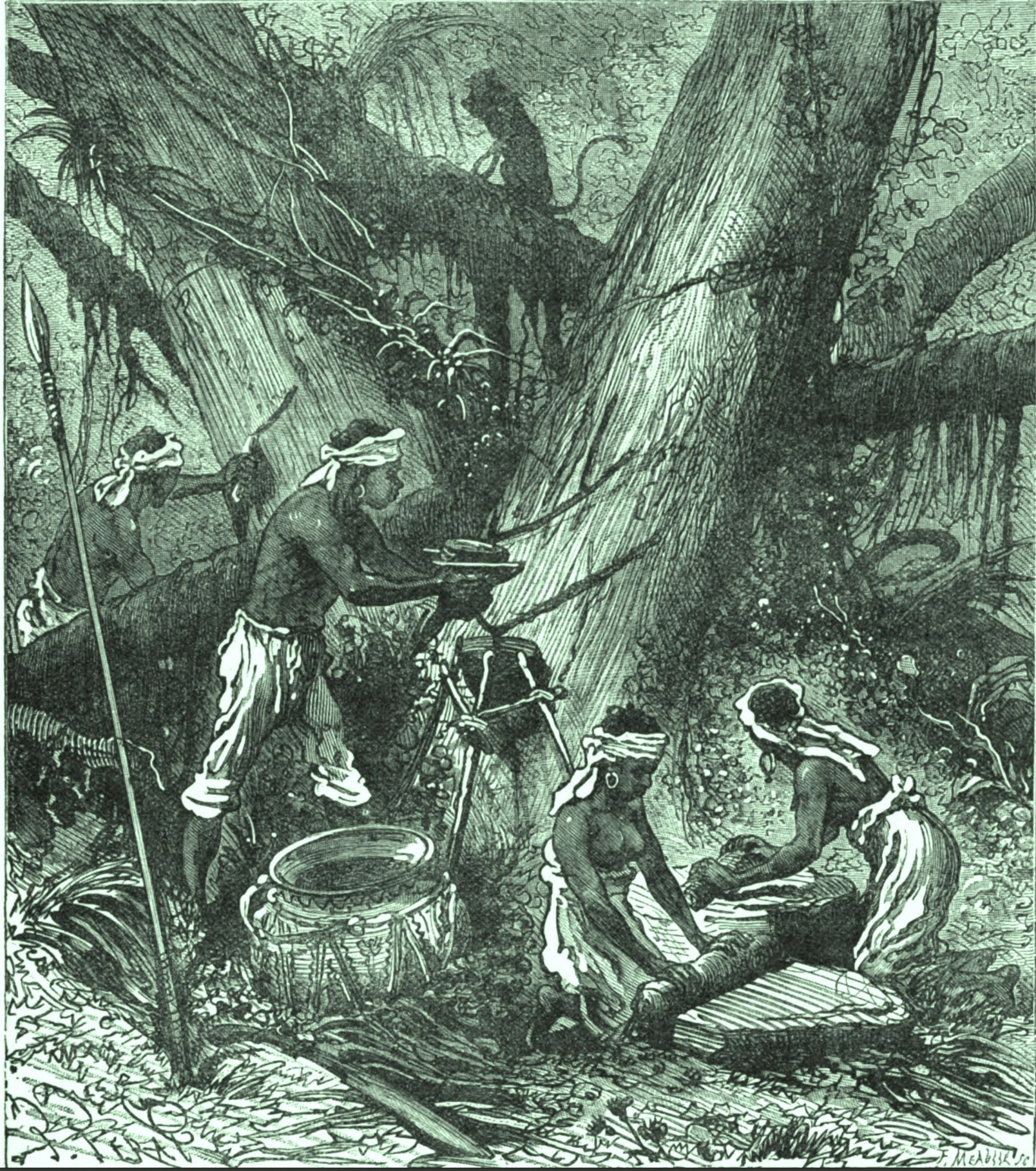

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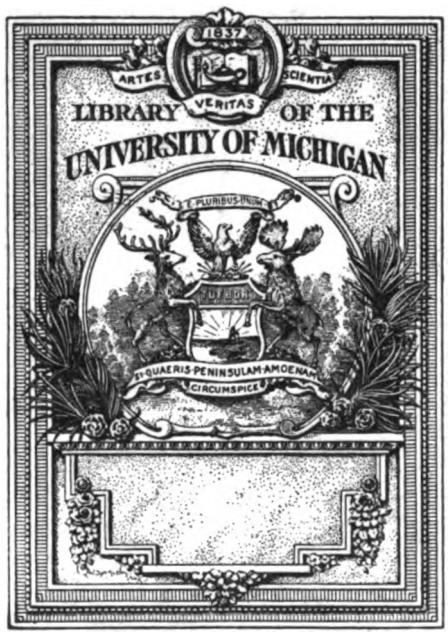

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THE ELECTRICIAN:

A WEEKLY JOURNAL OF

THEORETICAL AND APPLIED ELECTRICITY AND CHEMICAL PHYSICS.

No. 1.—Vol. VI. SATURDAY, NOVEMBER 20, 1880. Price 4d.

SLIP

South America.—Cable between Monte Video and Rio Grande do Sul is now repaired.

Mr. Swan's Lamp.—This electric lamp is patented in America. The number of the patent is 233,445.

Cincinnati Industrial Exhibition.—The front of this exhibition is illuminated by the Maxim electric light.

Simple Lessons.—These will commence on the completion of the Cantor Lectures, the last of which is begun in the current issue.

Dynamo-Machines.—Mr. E. Thomson and Messrs. Thomson and Houston have respectively patented improved dynamo machines in the States.

Death of M. d'Almeida.—We learn with deep regret the sudden death of M. d'Almeïda, inspector-general of public instruction, and secretary of the Société de Physique.—*La Nature.*

Cable Interrupted.—The Bahia and Rio de Janeiro cable is interrupted. Messages for Chili, Peru, Bolivia, the Argentine Republic, Uruguay, as also for Brazil, South of Bahia, are consequently delayed.

Menlo Park.—Mr. Edison is busily preparing for further tests of his electric light apparatus at Menlo Park. The new trials will be on a large scale, $7\frac{1}{2}$ miles of street-mains having been laid for the purpose.

Personal.—Cyrus W. Field has started for a trip round the world. He departed from New York on Tuesday, November 9, with his wife, for San Francisco, thence to Japan, China, Egypt, civilised Europe, and home.

The American Institute Fair.—The United States Electric Lighting Company light a portion of the Machinery Hall; while the Fuller Electrical Company light the main hall, and furnish lights at the front and back of the buildings.

The Photophone.—A correspondent of *L'Electricité* states that he has had an interview with Mr. Preece, from whom he learnt that Professor Bell had sent a long communication to Mr. Preece in view of his forthcoming lectures on the photophone.

Professor Graham Bell.—We understand that Professor Bell arrived in London on Thursday last, and that great efforts are being made to obtain a special evening for him to explain his recent discoveries to the members of the Society of Telegraph Engineers.

Society of Telegraph Engineers.—At the Ordinary Meeting of the Society on November 24, at the Institution of Civil Engineers, 25, Great George-street, Westminster, Mr. J. W. Swan, of Newcastle-on-Tyne, will read a paper on "A System of Subdividing the Electric Light."

At Last.—The South Metropolitan Gas Company is about to reduce the price of its gas to 2s. 10d. per thousand cubic feet. We think the hint may be taken by other companies, or a stronger competitor will creep in before they are aware of it. The electric light will not be denied.

Lighting Underground Railways—A correspondent of the *Globe* points out with reference to the proposed adoption of the electric light in London railway tunnels that the shadows would put a stop to newspaper reading in the carriages. No doubt they would. What is wanted in the underground railway is the suppression of smoke, not the extinction of gas.

The Anglo-American Company's Cable.—A few days ago notice was given that a fault had been developed in the Brest cable, some 200 or 300 miles from land. We are informed that the Telegraph Construction and Maintenance Company's ss. Scotia was despatched on Thursday last to effect repairs, and have no doubt that within a few days the cable will again be working.

West Indies.—In addition to the Porto Rico St. Croix cable, which has been broken for some time past, the Porto Rico St. Thomas cable is now interrupted. Telegrams reaching Porto Rico for those places and for St. Kitto, St. Lucia, St. Vincent, Antigua, Barbadoes, Dominica, Berbice, Demerara, Grenada, Guadeloupe, Martinique, Trinidad, &c., have to be forwarded by non-telegraphic agency.

The Telephone among the Indians.—The United States Fish Commission has lately connected by telephone its salmon hatching stations at Baird, on the McCloud River, California, with the establishment for breeding the California trout, five miles further up the river, and the apparatus is now in thoroughly good working order. The Indians look on in blank amazement, and call the instrument "Klesch-teen," or speaking spirit.—*Journal of the Telegraph.*

Lectures on the Photophone.—Owing to the legal proceedings between the Government and the Telephone Companies being put off from the 22nd to the 29th inst, Mr. W. H. Preece, President of the Society of Telegraph Engineers, has been compelled, owing to his official duties, to postpone his lecture on the Photophone at the Society of Telegraph

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Engineers till Dec. 8th, and for the same reason the lecture at the Society of Arts arranged for Dec. 1 has been deferred.

"BETTER IN FRANCE?"—*L'Electricité* complains that the announcement of the coming International Conference of Electricians and Exhibition first appeared in an English newspaper—the *Daily News*—and complains, very justly, as it seems to us, that news which was of primary importance to the scientific journals was communicated a long while in advance to a foreign political organ. State secrets are not proof against the special correspondent in France any more than elsewhere.

QUEEN-STREET STATION, GLASGOW.—According to a letter of Messrs. G. Bray and Co. they have orders to put up their gas lamps at this station, which is now lighted by the Crompton electric lamp. Messrs. Bray and Co. say perhaps the most interesting feature connected with the two systems of lighting being thus placed in competition is the opportunity it affords for the electric light being tested as to cost and utility in comparison with gas lanterns of improved construction for lighting railway stations. No doubt the results will be awaited with interest.

IRVINE.—Amongst the notices published of Bills for consideration in the ensuing session of Parliament, there is one issued by the municipal authorities of the burgh of Irvine, to which attention may be briefly directed. The Bill asks that the authorities may be empowered to purchase and hold the undertaking of the Irvine Gaslight Company, &c., and among other things, to provide or contract with any person or company for providing engines, works, appliances, and all necessary apparatus and materials for supplying electric light, and other light in addition to or in substitution for gas, and to use and employ the same for public and private purposes, &c. This is said to be the first Bill from a Scotch Municipality asking for powers in connection with the electric light.

THE ANGLO-AMERICAN COMPANY.—In our last issue we briefly noticed a letter, which appeared in a daily contemporary, relating to the action of one of the shareholders of this company. The information we can give concerning this letter is such as can be obtained by any shareholder on referring to the books of the company. The instigator of the said letter, so far as we can gather, is the holder of £50 of stock bought at £16. It is hardly to be credited that any one interested in a company, whose capital is reckoned by millions, to so contemptible an extent should be able to set at nought the decision of the directors, recollecting that the directors are not only, as a rule, large holders of stock, but are especially selected by the shareholders to carry on the business of the company. Just glance for a moment at what the directors of the Anglo-American have done. They have carried on the business and regularly paid a dividend. They have during the past few years laid two new cables out of revenue of a far better type than those in previous use, and besides this have still a fair reserve in hand. What more can be required?

THE ELECTRICAL SPUR.—As a supplement to the electrical bit, noticed by us some time ago, it may now be stated that Mr. G. Hüttmann, imperial equerry at Vienna, employs the electrical current in a very ingenious manner in order to facilitate the management of the horse, especially for ladies. To the left side of the saddle a small box, which contains a galvanic battery and an induction coil, is fastened. From this apparatus two silk-coated wires are conducted to a special girth-leather, which end into two blunt metallic brushes touching the flank of the horse at that place where usually the spur is applied. These wires are also connected with the riding whip, which has two ivory knobs. By a pressure of the finger upon one of these knobs the current is closed and conducted to the wire brushes, where it acts as a spur in a strong and sudden manner, while, when the other knob is touched, a weak and continued current is originated, acting like the pressure of the thigh of the rider. The electricity may not only be used by ladies, but will also prove useful to the equestrian performer in the circus in order to manage several horses at the same time, and to the groom in order to prevent horses from crib-champing and other bad habits. In Paris electricity is also used for preventing carriage horses from running away, a battery being connected with the bit of the horse.—*Scientific American.*

A SOLILOQUY TO A "THOMSON RECORDER."—Inanimate machine! so silent yet so potent—a combination of the massive with the most delicate—of ponderous electro-magnets with the imponderable levity of the silkworm's thread—of heavy copper wire with the lightest and finest ever drawn. With wonder and with admiration I view thee on thy pedestal, and well nigh adore the mighty mind that conceived thee in thine infancy. When first I saw thee, a decade since, in that stony isle (St. Pierre, 1870) thou wast as it were but a rough, unpolished diamond. Well have thy parts been developed and thy limbs improved since then; thy features now are barely recognisable. The silent force which drives thee—that subtle spirit which makes thee almost lifelike—keeps thee on thine endless track from day to night and night to day, whilst

> "All unseen and all unheard
> Swiftly speeds the secret word,"
> Under oceans, lakes, and seas
> To the far Antipodes.

Thy tiny siphon pen traces upon the "slip" these "secret words" and makes them intelligible. As move the fingers two thousand miles away, the record of their motion is here, by thee, most truly writ, and these minutest curves of thy fine-spotted line impart to human intellect the multitude of sentiments which the old and new worlds desire to interchange. Truly thou art a marvellous combination, a wonderful adaptation of subjugated matter to the services of mind, by which the lightning's puny representative is controlled for the purposes of man. And yet thou art but one of the legion of scientific conceptions permitted to be developed by man, the highest flight of whose genius and knowledge is but ignorance compared with that of Him whose wisdom is infinite.

PELTIER'S PHENOMENON AT THE CONTACT OF A METAL AND ITS SOLUTION.—In an abstract of a paper by M. E. Bouty, the *Philosophical Magazine* says:—Two coppered thermometers, as nearly equal as possible, and sensitive to 1-200th of a degree, were lowered at the distance of 1 decim. from each other, into a large vessel full of solution of sulphate or nitrate of copper, which stood in a large cold water bath. Thereupon the temperature of the solution changed in five minutes 1-100th of a degree only. Between the thermometers a current of the intensity i was conducted through during two minutes; the quantities of heat then observed on the two thermometers were proportional to $W = \mp ai + bi^2$, where a and b are constants. That the indications of the thermometers were in fact proportional to the quantities of heat produced upon them follows from experiments, in which they were surrounded in the fluid with German-silver spirals protected from the latter. On the passage

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of currents i_1 through the spirals the heatings were proportional to i_1^3. In absolute measure (centim., gram, second) the heat generated, simultaneously with Peltier's phenomenon, by the current E in a second is $\Pi = \frac{T}{A}\frac{dE}{dT}$, where A is the mechanical heat-equivalent, T the absolute temperature, and E the thermo-electromotive force. According to previous experiments by Bouty (*Beiblätter*, iv. p. 680), for copper $\frac{dE}{dT} = 0{\cdot}000696\,D = 0{\cdot}000696.1{\cdot}12.10^8$ absolute units. Since $J = 4{\cdot}2.10^7$, it follows that $\Pi = 0{\cdot}528$. Further, the thermometer employed was heated in the liquid in 2 minutes $0°{\cdot}471$, for which 4·77 thermal units are requisite. From the formulæ for W it resulted that during 2 minutes $a = 6{\cdot}018$. According to this, $\Pi = 6{\cdot}018.\frac{4{\cdot}77}{0{\cdot}471}\frac{1}{120} = 0{\cdot}5078$, which agrees very well with the above value. Similar results were given by salts of zinc and cadmium. Zinc in a solution of zinc chloride shows a constant thermo-electromotive force E in solutions the specific gravity of which is less than 1·6; with higher degrees of concentration E rapidly diminishes. Peltier's phenomenon Π behaves in just the same way. Thus,

Specific gravity	1·255	1·70	1·90	2·044
Constant E.....	1	0·724	0·247	0·053
Constant Π	1	0·709	0·244	0·051

With other metals the determination is difficult in consequence of secondary processes.

THE TELEGRAPHS ACTS AND THE TELEPHONE COMPANIES.—The Act of Parliament of 1863 relating to the powers of the then existing telegraph companies contains the following definition of the term "telegraph":—"The term 'telegraph' means a wire or wires used for the purpose of telegraphic communication, with any casing, coating, tube, or pipe inclosing the same, and any apparatus connected therewith for the purpose of telegraphic communication." This Act was embodied in the later Act of 1868, enabling the Postmaster-General to "acquire, work, and maintain electric telegraphs." The terms "undertaking" and "company" are herein defined as "the whole or any part of the electric and other telegraphs, &c., engaged in the United Kingdom of Great Britain and Ireland in transmitting messages for money or other consideration by means of electric or other telegraphs or mechanical agencies." In the subsequent Act, 1869, to amend the Act of the previous year, occurs the following definitions: — "The term 'telegraph' shall, in addition to the meaning assigned to it in 'The Telegraph Act, 1863,' mean and include any apparatus for transmitting messages or other communications by means of electric signals. The term 'telegram' shall mean any message or other communication transmitted or intended for transmission by a telegraph." Clause 4 proceeds to enact that the Postmaster-General "shall from and after the passing of this Act have the exclusive privilege of transmitting telegrams and performing all the incidental services of receiving, collecting, or delivering telegrams, except as hereinafter provided." The exceptions are as follow, and it is upon these, we understand, that the defendants chiefly rely, namely, "Telegrams in respect of the transmission of which no charge is made transmitted by a telegraph maintained and used solely for private use." Telegraphs belonging to corporations or companies are also exempted provided "no money or valuable consideration" is charged for the use of the same; and telegrams are also excepted if "transmitted with the written licence or consent of the Postmaster-General." Clause 6 enacts penalties for contravening what is therein again described as the "exclusive privilege" conferred on the Postmaster-General.

ELECTRIC LIGHTING COMPETITION FOR THE CITY.—With regard to the decision of the City authorities, full particulars of which we print below, we have no hesitation in expressing our regret that the Crompton lamp was not among the successful competitors. The trial is a purely experimental one, and there was no need to repeat the tests very fully carried out on the Thames Embankment and elsewhere. The exclusion of the Crompton lamp is the more surprising as the tender for it was, we believe, considerably under that for the Jablochkoff system. We may also remark that if the number of gas lamps to be displaced by the respective electric systems affords any indication of the amount of light to be substituted, the figures present some extraordinary anomalies. The Brush system will supersede 150 gas lamps, at a cost of £1,410. To supersede 161 gas lamps—that is, only eleven more than are covered by the Brush system—the Electric and Magnetic Company (Jablochkoff system) are to be paid £2,930; while Messrs. Siemens' system will cost no less than £3,720 for superseding only 138 gas lamps. The number of lights is the same for the lowest as for the highest tender, namely, 32; for the Jablochkoff 52 lights will be required:—A meeting of the City Commission of Sewers was held on Tuesday, at the Guildhall, for the transaction of public business; Mr. Rudkin, the chairman, presiding. A report was brought up by Mr. Innes from the Streets Committee on the subject of electric lighting in the City. They stated that they had received a variety of tenders, in considering which they had been guided not only by the prices mentioned, but by the effect produced by the different systems in actual operation, all of which they had seen. They had decided, for the purpose of the experiment, to divide the streets into three districts, each of them including one of the City bridges. The first district would comprise Blackfriars Bridge, New Bridge-street, Ludgate-circus, Ludgate-hill, St. Paul's Church-yard (north side), and Cheapside as far as King-street. They recommended that the tender for this district of the Anglo-American Electric Light Company (Brush system) should be accepted, at a cost of £1,410 for the twelve months. The number of electric lamps would be 32, replacing about 150 gas lamps. The second district would comprise Southwark Bridge, Queen Victoria-street, lower part of Queen-street and Queen-street-place. They suggested the acceptance of the tender of the Electric and Magnetic Company (Jablochkoff system), at a cost of £2,930 for the twelve months. The number of electric lamps would be 52, replacing about 161 gas lamps. The third district would comprise London Bridge, upper part of Queen-street, Cheapside (between King-street and the Poultry), King-street, Guildhall-yard, Poultry, Mansion House-street, the Royal Exchange, King William-street, and Adelaide-place. For this district they advised the acceptance of the tender of Messrs. Siemens Bros. at a cost of £3,720 for the year. The number of electric lamps would be 32, replacing 138 gas lamps. On a rough calculation, the cost, including the plant, &c., would be about four times the price now paid for gas lighting; but eliminating the expenses which would not recur, the cost would be only twice that of gas. The Commission unanimously adopted the report of the Committee and the experiment will commence on the 1st of February next.

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS BOLAS, F.C.S.

(CONTINUED FROM PAGE 305, VOL. V.)

LECTURE VI.—DELIVERED MARCH 8, 1880.

Gutta percha. Sources. Chemical nature and physical properties. Applications in connection with the industrial arts. Vulcanisation of gutta percha.

Gutta percha is quite secondary to india rubber as regards the number of its industrial uses, but there are cases in which it could be but ill replaced by india rubber. It differs from rubber, principally in being more readily softened by heat, in being far less porous, and in lacking that ready extensibility by tension which is especially characteristic of caoutchouc.

The *Isonandra gutta*, a fine tree, which often grows to a height of over 80 feet, and whose stem attains a diameter of three feet or more, is the principal source of the milky juice or sap which, when indurated, forms the crude gutta percha of commerce. The *Isonandra gutta* flourishes notably in Singapore, the eastern part of Sumatra, Borneo, and Java. The lantern slide now projected on the screen (Fig. 31), will serve to illustrate to you the appearance of the foliage, flower, and fruit of the tree in question; and next I will show you a slide which represents the operation of collecting the juice or sap (Fig. 32).

The *Isonandra acuminata*, also an East Indian tree, yields some gutta percha; while the *Sapota mülleri*, or South American bully tree, has of late years afforded a considerable supply of an excellent quality of gutta percha, which passes under the name of "balata."

Gutta percha appears to have been first introduced into this country by Jose D'Almeida, who, in April, 1843, presented some of the raw material, and also a riding-whip made of it, to the Royal Asiatic Society. Some months afterwards, Dr. Montgomerie presented some of the material to this Society, and a portion of it having been given to Charles Hancock, this gentleman immlediately took steps to prove its applicability to various industria purposes; and the foundation of the gutta percha industry may be said to due to him.

The operation of collecting the sap of the gutta percha trees (Fig. 32) is not very different from the corresponding operation with the juice of the rubber trees. But as the gutta percha juice sets readily, no smoking is required, it being sufficient to roll the concreting sap into rough balls or cylinders.

On the table you will find a very interesting collection of samples of raw gutta, some of which are roughly modelled into representations of animals, while others are of interest as enclosing stones, lumps of wood, and other adulterating materials. For the greater part of them I am indebted to the Gutta Percha Company of London.

The essential ingredient of gutta percha is white, and appears to be identical, as regards ultimate composition, with caoutchouc. Faraday gives the following figures as the result of analyses of these bodies:—

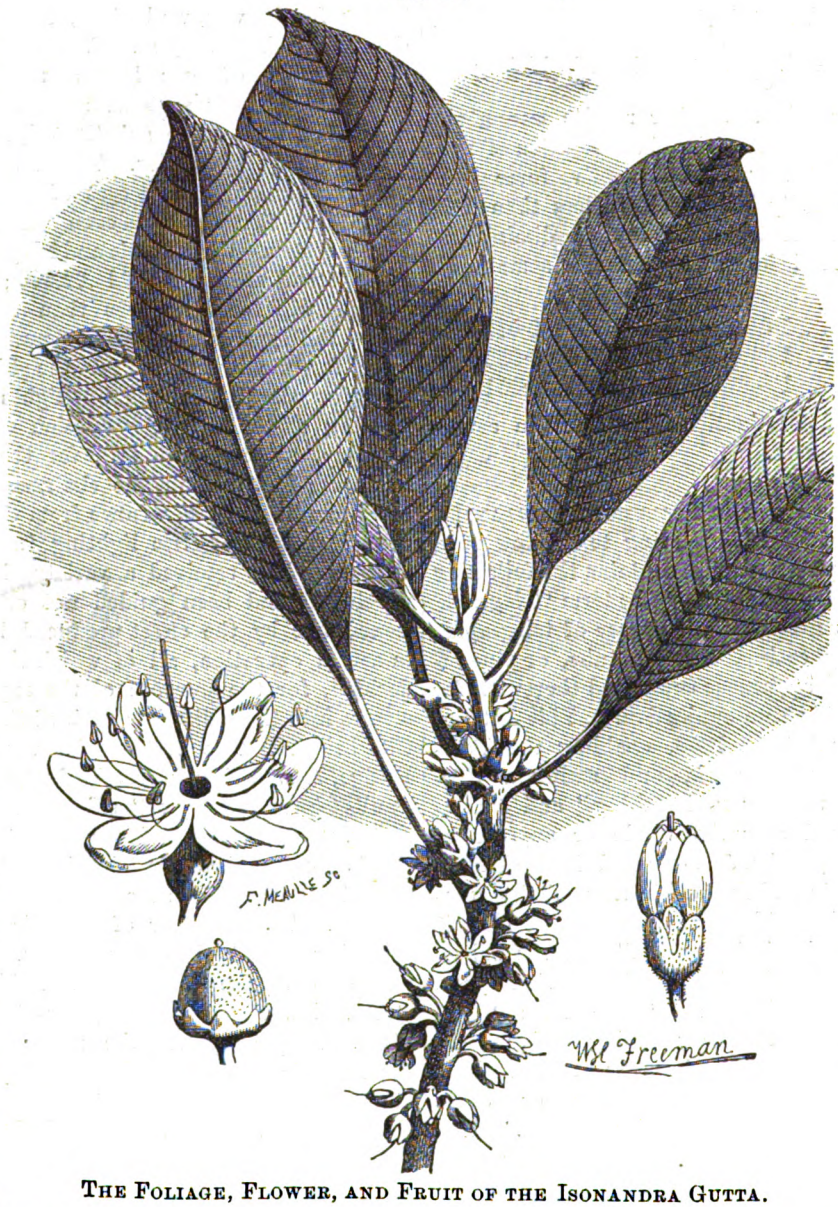
	Gutta percha.	India rubber.
Carbon	87·2	87·5
Hydrogen	12·8	12·5
	100·0	100·0

The purification of gutta percha can be readily effected by dissolving the crude material in carbon di-sulphide, and, after filtration, evaporating the solution. Here is some carbon di-sulphide, and you see how readily these parings of raw gutta dissolve in it. Let us now filter the solution, and pour some on this levelled glass plate. The solvent will soon evaporate and leave a skin or film of gutta percha. Here is such a skin, or sheet of gutta percha, which is now ready to be stripped from another plate, as the solution was poured on this glass about an hour ago. You see that it is nearly white, and when softened by heat it becomes most perfectly plastic. The method of purifying gutta percha just demonstrated was proposed by Parkes, as the foundation of an industrial process for refining gutta percha; but mechanical purifying methods have been generally adopted on a large scale.

Purified gutta percha, as now shown, consists of three constituents. The most important is pure gutta, or the plastic principle; and this forms about four-fifths of the whole. Its chemical composition corresponds nearly with the formula $C_{10}H_{16}$, and it is perfectly white. An oxidised principle, called albane, of which a specimen stands before you, is present to a considerable but variable extent. It forms a white crystalline body, which is soluble in hot alcohol, and corresponds in composition to the formula $C_{10}H_{16}O$. Albane is valueless in gutta percha; indeed, it is detrimental, being doubtless, like the body which is to be next alluded to, a product of oxidation or decay. The third constituent of the purified gutta is called fluavile, and forms a yellow oxidised resin which is soluble in cold alcohol, and has a composition which may be said to correspond with the composition $(C_{10}H_{16})2O$. It is often present to the extent of 4 to 5 per cent. in gutta percha of good quality, while the amount of albane contained in good commercial gutta often reaches 20 or 25 per cent.

Like caoutchouc, gutta percha is attacked by ozone with great energy, and when exposed to the ordinary conditions of the atmosphere it becomes oxidised and brittle with so much rapidity that old articles made of gutta percha are usually brittle and useless. Most liquids which dissolve caoutchouc also dissolve gutta percha; but in the case of the gutta there can be little

FIG. 31.



THE FOLIAGE, FLOWER, AND FRUIT OF THE ISONANDRA GUTTA.

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doubt that true solutions, rather than starch-like magmas, are formed.

Gutta percha resists the action of alkaline liquids and of dilute acids, but strong and slightly warm sulphuric acid chars it readily, while concentrated nitric acid converts it into a yellow resinous body. Like caoutchouc, gutta percha is an admirable electrical insulator, and also a very useful non-conductor of heat.

When submerged in water, or in any way protected from the action of air and light, gutta percha has little or no tendency to change; while, on the other hand, constant exposure to light, together with alternating conditions of dryness and dampness, is most unfavourable to its well-being. The products formed by its oxidation are of a resinous nature, as in the case of caoutchouc; one of the most notable of these being a body resembling Spiller's caoutchouc resin, and containing 27·9 per cent. of oxygen. It occasionally happens that samples of gutta are met with which resist decay in an extraordinary manner. Here, for example, is a sample of thread which Mr. Walter Hancock has had in his possession for over 20 years, and you will note that it is tough and strong like new gutta. Other samples kept under similar conditions fell into dust as soon as they were touched, and Mr. Hancock tells me that he cannot account for the difference between them.

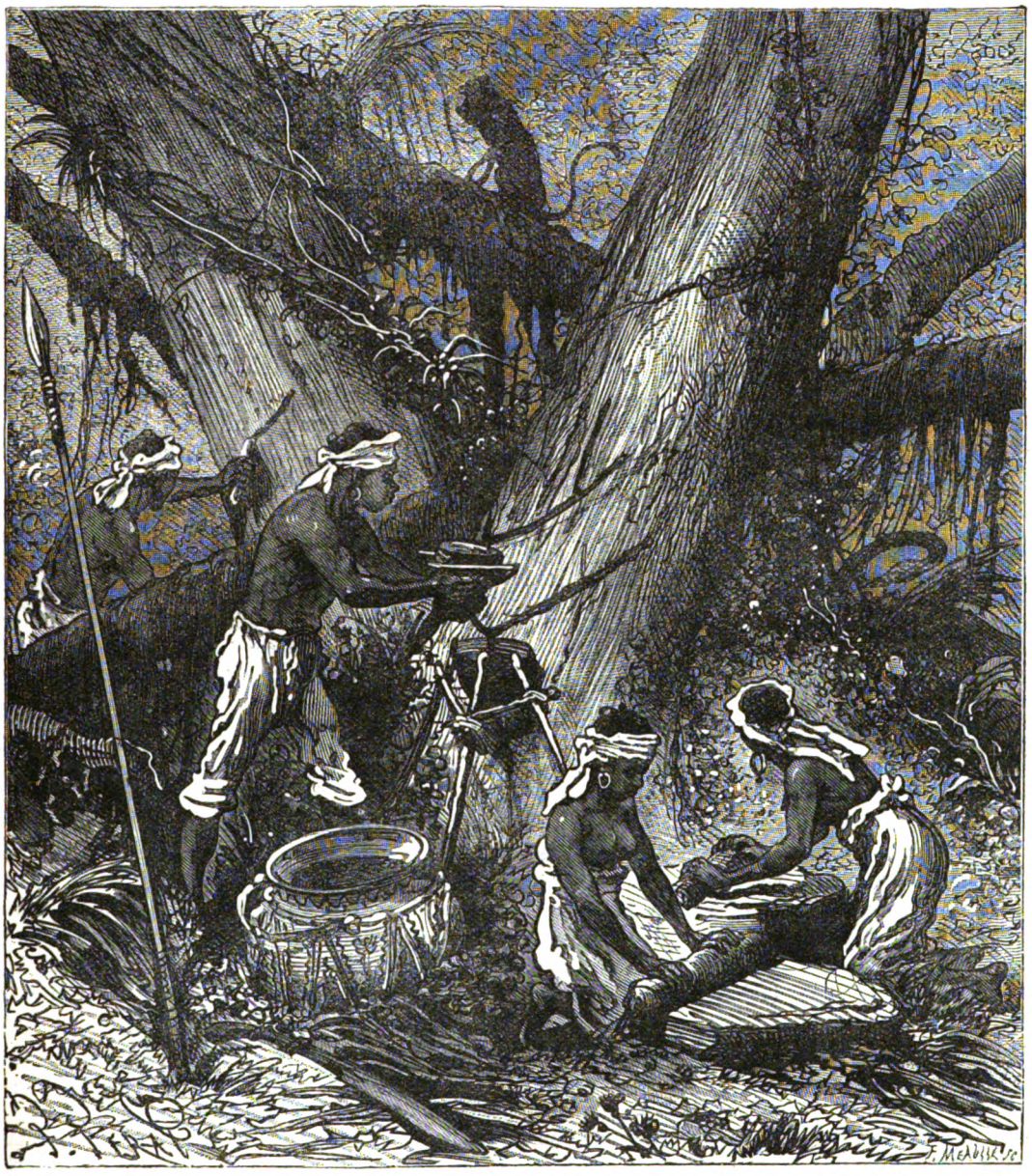
A temperature of 50 deg. Centigrade serves to soften gutta percha to such an extent that it may be easily moulded into any required form, while at 100 deg. Centigrade, it becomes adhesive and pasty, and at 130 deg. it may be said to fairly melt. The products of the dry distillation of gutta percha are generally similar to those obtained by the distillation of caoutchouc.

In the next place, let me very briefly call your attention to the methods employed for effecting the purification of gutta percha on an industrial scale, these being, in the main, due to Charles Hancock.

The first operation is to chop up the crude gutta into slices o shavings, by means of knives or cutters attached to the face of a revolving wheel. These knives are now often made with saw-like edges, each tooth being sharpened like a lancet; and it is found that the effect of this modification is to reduce the gutta into small fragments, like raspings. The finely-divided gutta is next soaked and boiled in water, in order that particles of earthy matter may sink, while the gutta floats. During this process many particles of woody matter become so far sodden with water as to disengage themselves from the gutta and to sink, while any soluble impurities naturally become pretty thoroughly removed.

(TO BE CONTINUED.)

FIG. 32.



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THE PUBLIC AND THE TELEPHONE.

Crown lawsuits are more uncertain even than Crown prosecutions. Of the guilt or innocence of a political offender everyone is able to form a tolerably correct opinion beforehand, and the chief element of doubt is the eccentricity of a British—or Irish—jury. But in an action brought against private individuals for the enforcement of rights involving revenue the issue is often complicated by a number of considerations, many of which are never made public at all, and many that are neither legal nor technical but simply matters of expediency. Public policy, deference to public opinion, on the one hand, and commercial prudence on the other, may from time to time modify the case as it proceeds; and there is no telling what views even the judges—to say nothing of the jury—may entertain with regard to questions which have always the semblance of attacks upon private enterprise. It is this seeming greed on the part of the Crown which alienates from it the sympathy of the public, although it is obviously for the interests of the public that the Crown is doing battle. The Government is placed in this ungracious position at the present moment with regard to the Telephone Companies. It cannot be doubted that the suit to be opened next Monday week to assert the supposed rights of the Post Office Telegraphs against the pretensions of their rivals has been instituted in good faith, and with a proper solicitude for national property, of which the Government is the accredited guardian. On the other hand, it is plain that the public themselves are on the side of the private companies, partly for reasons we have already mentioned, but partly for others which have special reference to this particular case.

In the first place there is a wide-spread apprehension that if the telephone companies fail the telephone itself will disappear with them. "Telephone or no telephone" is the issue which has been raised in popular prints; and false as this issue obviously is it is nobody's interest, save that of the Government, who are necessarily silent, to correct it. Again, there is the prevalent suspicion that the postal officials seek to make a profit out of the telephone, and that their terms will not be so easy as those of the companies. A clear statement on the part of the Crown would remove this impression if it is a wrong one. Lastly, and perhaps chiefly, there exists a fixed conviction in the mind of the public that a message spoken into a telephone is not a telegraph message, and that consequently the State telegraphs have nothing to do with it. This is an issue—one aspect of it at least—which will come before the Courts, and upon which we must, therefore, refrain from passing an opinion. But in order to make the real issue a little plainer we are at liberty to explain how it has arisen, and what are the arguments for and against the contention.

On the part of the general public the view that a phonogram—if we may coin a convenient barbarism—is not a telegram is natural enough, especially when the argument is backed by pecuniary considerations which unrestricted vocal communication seems to afford. People are not taxed for speaking through a tube, and the main practical difference between a leaden pipe and an iron wire is to the common understanding one merely of length. The wire will carry farthest and costs less—that is all. Moreover, this speaking wire and its belongings were contrived, made public, and rendered practicable, not by the Post Office, but by private ingenuity and capital. The benefactor in this instance is, so to speak, a personal acquaintance, and as there has been no intentional or self-evident invasion of State rights, so there has been no real invasion.

The case of the promoters themselves is—one portion of it, at all events—equally specious. They say they are not carriers of telegrams, any more than they are carriers of letters. They do not charge for messages as messages; they merely provide a means of communication just as the bellhanger does, or the plumber who fits up a speaking tube. That their wires are rented, as telegraph wires are rented, is an accident of convenience, and that the signalling apparatus is electrical is also an irrelevant accident, just as is that of the electric bell. More than this, it is alleged that the revenue is not revenue diverted from the telegraph administration, but is fresh revenue, from a wider if not a different source, and is the property, therefore, of those who discovered it.

It will be seen from this brief statement of their case that the novelty of the discovery and the exceptional character of the service it is capable of performing constitute the chief claim of the telephone companies to an independent existence apart from the telegraphic systems of the Government. If anybody started semaphore signalling and made a charge for its use, or if a company were to transmit despatches—sealed or open—by pneumatic pressure, there would, we imagine be no second opinion as to their illegality. But about a phonogram a doubt has been raised, and the public, so far, have given the benefit of it to the forces that are hostile to monopoly.

We have confined ourselves, it will be observed, to the popular aspect of the question. Concerning its electrical bearings, our readers are as well able to form an opinion as

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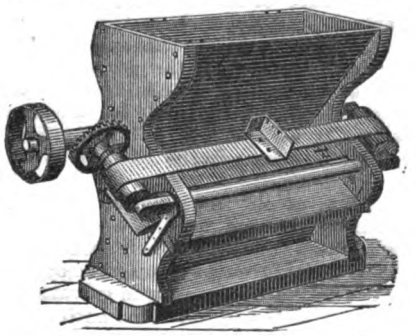
ourselves. To most of them we should imagine there would appear no room for conflict at all. But this is evidently not the view entertained by the litigants. Judging by the array of scientific experts subpœnaed on either side there is to be a dispute as to what constitutes an electric telegraph instrument—at all events we cannot conceive what their presence in the suit at all means if not to argue this point. The spectacle will not be edifying, and on several grounds it is much to be regretted. Scientific definitions admit of great variation, and, framed in the atmosphere of an angry law-suit, they cannot be expected to be very instructive. The interpretation which the Court may put upon the scope and intention of the Act of Parliament that gave the Post Office a certain monopoly will probably outweigh professional opinions on a purely technical point. Whatever the result may be, however, we hope and trust that the convenience conferred upon the public by the introduction of the telephone will in no way be curtailed.

In another column we print at length the chief clauses of the Telegraph Acts bearing upon the dispute; and from them rather than from the superficial views prevailing in popular prints our readers will be able to form an opinion as to the strength of the case for the Government.

THE MAGNETIC SEPARATOR.

This is used for automatically removing metallic substances from grain. As the harvesting and thrashing of all kinds of grain are now done almost exclusively by machinery, and since the introduction of wire-binding attachments to the reaper, magnets in some form for removing pieces of wire and other metallic substances from the thrashed grain have become an absolute necessity. Heretofore gang magnets, placed in spouts through which the grain flows, have been used. With this method, however, after a certain amount of metal has been collected by the magnets, it is necessary to remove them and brush it off by hand, and unless the flow of wheat is stopped the material to be taken out passes on with the grain. If the magnets are left too long in the spouts without being cleaned, the metallic material is carried by with the grain, and the consequence is that more or less of the material sought to be removed is left in the grain. The new mag-

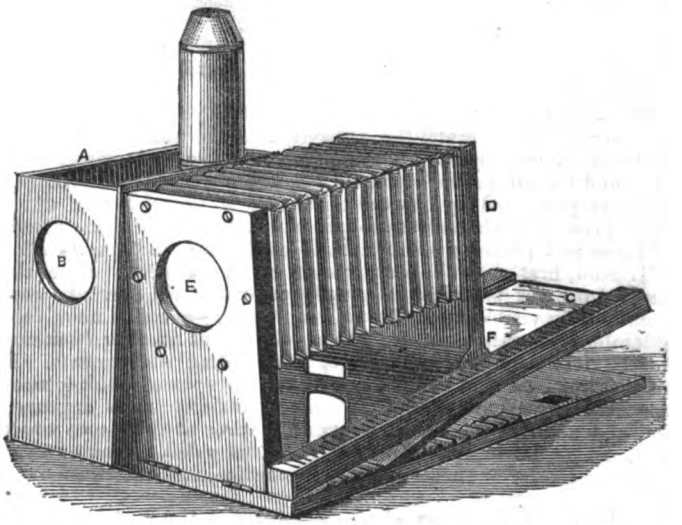


netic separator does this work effectually as well as automatically. The grain is fed into the hopper, from which it passes over a zinc plate the entire width of the machine. As this zinc plate is placed on poles of magnets, any metallic substance in passing with the grain over the magnets is held by the attractive force of the magnets until removed by the wiper, which, being attached to an endless belt, passes once a minute over the magnetic field, carrying off the metallic substances, depositing them in a box at the side of the machine. This process relieves the miller from care, and prevents metallic substances from going with the grain to the burrs or rolls, as the case may be, unless introduced after it has passed the machine. To prevent this, the separator should be placed as near the burrs or rolls as circumstances will admit.

DISPERSION PHOTOMETER.

It will be remembered that Professors Ayrton and Perry described to the Physical Society during the last session a photometer which they had invented. We referred to the description in our report of the society's meeting at the time (*The Electrician* Vol. IV., p. 257); and the invention was fully described in the *Philosophical Magazine* for 1879. Previous to the description of this instrument, the known photometers required a dark chamber of considerable size for the measurement of strong electric lights. Any invention, therefore, which simplified such measurements was likely to be welcomed, and to prove of considerable value. The principle of Messrs. Ayrton and Perry's photometer is simply that instead of weakening the light to be measured, by illuminating a screen at a great distance from the source, the same effect is obtained by passing the light through a lens. Instead of a chamber with a length of sometimes from 80 to 100 feet, a space of only a few feet suffices for the measurement of a powerful electric light with this apparatus. Dr. Hopkinson, in his experimental researches with the electric light, uses a photometer of a somewhat similar kind, but, so far as we can ascertain, had not published any account of the instrument when Professors Ayrton and Perry read their paper. Stevenson, about thirty years ago, suggested the use of a converse lens (Professors Ayrton and Perry use a concave lens), but never made the instrument. The illumination of the screen on which the lens-directed light falls depends on the focal length of the lens and its distance from the source of light.

The instrument as made by Messrs. Latimer Clark, Muirhead and Co., is illustrated below:—



The Standard candle in A is lighted and it illuminates the paper screen B, the base of the candlestick being brought against a wooden stop, which has been so placed that the centre of the candlestick is 7·23in. from the paper screen. The frame C is elevated until the light from any source to be measured passes through the lens at D to illuminate the screen E. A black cloth is used, as with a camera, over the head and shoulders of the observer, who moves the end DF, which carries the lens backwards or forwards until the illumination of E appears to be the same as that of B, when the reading on the scale marked by the pointer on F is taken.

This reading is multiplied into the distance (in inches) of the lens from the source of light, and the square of the product expresses the value of the source of light in terms of the light from the standard candle; or the observer may measure once for all the distance in inches, d, of the source of light from the zero of the scale. Then if r is the reading on the scale, the power of the light is—

$$r^2 \times (d - 13{\cdot}88r)^2 \text{ for the weak lens } a,$$
$$r_2 \times (d - 3{\cdot}76\,r)^2 \text{ for the strong lens } b.$$

Two scales are marked on the instrument. The coarser scale A A is to be used with the weak lens A, and the finer scale B B is to be used with the stronger lens B. The lens A will suffice for the measurement of sources of light of from 100 to 4,000 candle-power, so that the lens B is only needed for exceptionally-powerful lights. Indeed, by increasing the distance of the source of light from the lens to, say 10 feet, or diminishing it to two feet, we get a range of measurement from 40,000 candles to 92 candles, so that the lens B need not be used even for very powerful lights unless the available space for measurement is very small indeed. The holes in the brass slide in front of the lens are for the purpose of preventing the entrance of unnecessary light. In

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very accurate measurements of powerful lights the smaller holes ought to be used, but in practice it is found that the brass slides may be dispensed with. The instrument is accompanied by a sheet of ruby-red glass and a sheet of signal-green glass. The inventors also recommend a thin glass cell containing a solution of sulphate of copper. The strength of an electric light being required, it is first measured when the two screens of paper E and B are viewed through red glass, and then when they are viewed through green glass.

The following is an example of the measurement of a certain electric light taken by a workman using this instrument :—

1,606 candles through red glass.
2,900 ,, through green glass.

It will be seen that this instrument possesses the great advantage of extreme simplicity, so that anyone can use it.

EARTH CURRENTS.

By ALEX. J. S. ADAMS, of the Postal Telegraphs, Associate Telegraph Engineers.

In accordance with a promise given in your issue of August 21 last, I take up my note-book for some fifteen years past in reference to the complex subject of "earth currents," and offer from it the following remarks, not only for those of your readers who have made the subject their study, but for those also to whom "earth current" is little more than the name of a natural mystery—an enigma they have much opportunity, but apparently little inclination, to investigate—although, indeed, perhaps the greatest mystery about it is that the scientific societies of our day should themselves so long have left practical systematic investigation of the phenomenon in abeyance.

My own investigation commenced in the year 1866, and has steadily continued until the present, and the results of which I will endeavour to relate in as simple a manner as possible. To this end I shall lay before your readers the various distinctive features presented by the earth current in the order in which they presented themselves to me, and I think the more recent of these will prove to be not a little interesting and remarkable.

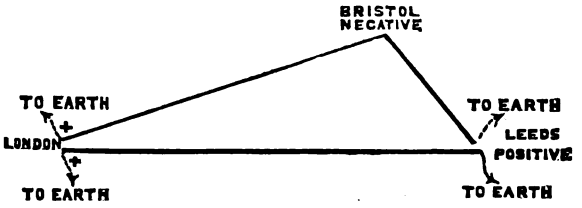
1. And, first as to the existence of earth currents. From the earliest days of practical telegraphy stray electric currents were occasionally visible upon the telegraph lines—at one time of considerable strength, upsetting the apparatus, at another weak and barely visible upon the needles of the working instruments. It soon transpired that these vagrant currents were nothing more nor less than currents of natural electricity that appeared to wander hither and thither over the wires at their own sweet will; no matter in what direction a wire extended, sooner or later, and for a longer or shorter period of duration these earth currents were sure to appear.

2. The currents thus observed appeared transitory, and of only occasional occurrence, but whenever a sensitive reflecting galvanometer was used in place of the heavier needle the earth current invariably became visible, so that at the end of several years' observations it was evident that earth currents, strong or weak, were perpetual.

3. One of the most important features was the fact that, whilst the ordinary and constantly occurring variations were very limited in extent, at times currents of enormous magnitude, sufficient to upset the working apparatus, would appear, and after sweeping to and fro over the wires for a short period would disappear, and, moreover, that whilst there was nothing jerky about the usual variation, but rather a sluggish wave-like pulsation, the great temporary currents were *very* variable, their variations taking more the character of contact currents, or of strong induction. Thus it became evident that the usual earth current was distinctive from the more temporary and stronger forces, and we shall, consequently, remember the former as the *earth current* proper and the latter as the *electric storm current*. This feature was, so far as I am aware, first pointed out in a paper read by myself before the Society of Telegraph Engineers in December, 1877.

4. The question then arises, are earth currents atmospheric? *i.e.*, are they contained in, and conducted by the atmosphere?

It transpired that—if the wire was a good one as regards its insulation—only so long as the two ends of the wire were in connection with the earth the earth current remained visible, but that upon either end being disconnected from the earth all current disappeared; the earth current therefore came from the ground to the wire at one end, and passed into the earth again at the other. Again, when two wires were arranged as in the figure, one going from London to Leeds *direct*, Leeds being electrically positive to London, whilst the second wire passed round through Bristol to Leeds, Bristol being negative to London, it was found that both wires presented a positive current to London, the negative polarity at Bristol in no way affecting the result.



Hence we find that earth currents are materially contained and conducted, *i.e.*, by the surface of our globe, and not by the atmosphere.

5. Now, ignoring for the present the electric storm currents, we will devote our attention solely to the earth current proper, and seek to ascertain if it be under the influence of *law*. Instead of one wire, we now have for the conduct of our investigations a number of wires radiating from London in various directions, say to Bristol, Birmingham, Nottingham, Lowestoft, Margate, Brighton, Southampton, and Salisbury, (it will much assist your readers if they draw lines upon a small map from London, as the central point, to the places mentioned), and we note the strength of the earth current upon each and all, as simultaneously as possible, once every hour during the night, and afterwards compare the result of one hour's observation with the others, giving the figures in the form of curves.

(TO BE CONTINUED.)

THE ELECTRIC RESISTANCE OF GLASS.

Mr. Thomas Gray, Demonstrator of Physics and Instructor in Telegraphy at the Imperial Engineering College of Tokio, Japan, has made a series of careful experiments on the electric resistance of glass at different temperatures, with a view of finding whether the variation of resistance with temperature followed a law sufficiently definite to allow the resistance at low temperatures of highly insulating glass to be approximately calculated from its measured resistance at high temperatures. The chief object was to use this law, with results obtained by the galvanometric method of measuring resistance, for the comparison of specific resistances of different kinds of glass.

Published results of experiments on various substances, such as gutta percha, india rubber, glass, &c., as well as experiments of Mr. Gray on other substances, led him to expect that the resistance of glass might possibly be expressed by an equation of the form

$$\log R = C - C' t,$$

where R is the resistance of the material, t the temperature, and C and C′ constants depending on the nature of the material. He is of opinion that some such law as this will be found to hold for all dielectries when the effects of the permanent changes produced in the glass by heating are eliminated. These changes are, he finds, of considerable magnitude in the case of glass; and it is to them especially he specially calls attention in the paper we quote from, which appears in the *Philosophical Magazine* for October.

With the exception of one experiment, in which a Thomson quadrant electrometer jar was used, the results were obtained from ordinary glass test tubes which had lain in store for years at the College. The resistances were measured by direct deflection of the needle of a very sensitive astatic galvanometer produced by the current through the glass. The battery used was commonly ten Daniell cells; but at low temperatures a battery of 110 Daniell cells was sometimes employed. Mr. Gray was thus able to measure a resistance equal to 2×10^{14} ohms per cubic centimetre in his test tube experiments, and equal to 14×10^{14} in his electrometer jar experiments. The test tube glass had generally a resistance considerably below the former figure, even at low temperatures; but the electrometer jar reached the latter figure at a temperature of about 100° C.

The advantage in these experiments of using this galvanometric method of measuring the resistances, rather than the method with electrometer and condenser of great capacity, was the ease with which the temperature and resistance could be simultaneously observed.

In determining the resistances two methods of observation were employed. One consisted in passing the current through the glass first in one direction and then in the opposite direction, and taking the deflection in each case half a minute after the battery had been applied. The mean of these deflections was

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then taken as the deflection corresponding to the resistance to be measured; and the mean temperature was taken as the temperature of that particular determination.

The second method consisted in passing the current continuously through the glass during the whole experiment, and taking deflections by short circuiting the galvanometer.

The first method gives the resistance before any very great amount of polarisation has taken place, at least before more than is proper to that temperature has taken place. The second method gives during the heating pretty nearly what is believed by some to be the true resistance; but it also shows whether more or less polarisation takes place when the temperature is high than when it is low. It therefore gives some indication of the effect of the current flowing constantly through the glass while its temperature is being changed.

The results which Mr. Gray has obtained agree with the well-known result that the resistance of a piece of glass diminishes as the temperature is raised; but they also show that the resistance varies more slowly when the glass is cooling than when it is being heated, and that a piece of glass may have its resistance greatly increased by being slowly raised to a high temperature and slowly cooled. There seems, therefore, to be what may be called a permanent change in the quality of the glass, which takes place coincidently with a quasi-elastic change in the quality; and a comparison of the results obtained when the glass was cooling with those obtained when it was being heated, showed that some such equation as that which has been stated above probably expresses this latter change. Whether the former change is really permanent or not (that is, whether the glass retains this increase of specific resistance at low temperatures) Mr. Gray is not yet in a position to say with certainty; but from observations which he has made Mr. Gray is inclined to think that slow changes take place in glass, tending to raise its conductivity and also its specific inductive capacity. He is not aware that any considerable deterioration in the insulating power of glass stems and electrometer jars has been detected; but in such cases the experiments point to at least a temporary cure, namely, *keeping the glass at a high temperature for a considerable time*. This accords with the treatment sometimes adopted for badly-insulating ebonite.

CORRESPONDENCE.

TELEDYNAMICS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I have not by me Pielet's "Treatise on Heat" by which to verify Mr. Paget Higgs's figures relating to the number of calories which an iron wire might lose when heated to a temperature of 48 deg., and submited to an atmosphere of 18°C. I believe, however, in the first place that these figures are considerably exaggerated, and in the next, that a telegraph wire of No. 8 B.W.G. could not be practically utilised for transporting motive power to a distance, by causing it to be traversed, as indicated by Mr. Paget Higgs, by a current of 390 webers.

In fact, a current of 390 webers, traversing a wire 1,000 feet long, with a resistance of 3 ohms, will represent per second a total expended energy which may be expressed in kilogrammetres by the formula,

$$W = \frac{Q^2 R}{9{\cdot}81} \text{ kilogrammetres per second.}$$

$$W = \frac{(390)^2 \times 3}{9{\cdot}81} = 37462 \text{ kilogrammetres.}$$

That is to say, an energy in *horse-power* of $\frac{37462}{79} = 499{\cdot}5$ horse-power expended in the conductor in the form of heat in order to carry the motive power 300 metres (1,000 feet in distance). Thus, whilst the wire No. 8 B.W.G. might have been traversed by a current of 390 webers, "*with perfect safety and without appreciable heating effect*," the loss which I indicate points out sufficiently that it would be of no interest to attempt practically such a mode of transmission.—Yours, &c.,

Nov. 14, 1880. E. HOSPITALIER.

A NOTE ON EXNER'S PAPERS ON CONTACT ELECTRICITY.

BY PROFS. W. E. AYRTON AND J. PERRY.

The authors' attention was drawn to Prof. Exner's papers about a year ago by Prof. Fleeming Jenkin, but on reading them it did not seem necessary to answer them. Finding now, however, that they have been translated and reprinted several times, and that they are calculated to mislead, it has been thought well to bring a criticism of them before the society. Starting from Thomson's (or Joule's) well-known theory that the heat of combustion, due to the chemical actions going on in a cell, represents the E.M.F., Exner states that the difference of potential between zinc and its oxide, which he calls 2 E, is measured by the heat due to oxidation of zinc. If, now, a non-oxidisable metal, say platinum, is brought into metallic connection with the zinc there is no difference of potential between the zinc and platinum, the platinum takes part of the charge of the zinc, and the difference of potential between the platinum and the oxide of zinc becomes E. And from this it follows that the difference of potential between two metals in contact in air is measured by half the difference of their heats of combustion in oxygen. To show that his reasoning is correct, Exner has made experiments on three contact differences of potential, which agree very remarkably with the theory. The authors first consider Exner's theory, and show that, even if they allowed the first assumption, the reasoning disregards what is known of the laws of electricity, for Exner does not assume a constant difference of potential between zinc and its oxide since this begins at 2 E and ends with E; neither does he assume a constant quantity of electricity in the oxide, for in that case his last difference of potential would depend altogether upon the condensing arrangements employed in the experiments. So that Exner has simply assumed what a casual reader might think he had proved, viz., the above statement as to half the difference of heats of combustion. But if the statement agrees with experiment, Messrs. Ayrton and Perry showed that it might be regarded as a most important empirical law. Now, Professor Hoorweg has shown in a paper in *Wiedemann's Annalen* that Exner's experimental results are in complete disagreement with those of Kohlrausch, Hankel, and Ayrton and Perry, and gives the following table:—

		Kohlrausch.	Hankel.	Exner.	Perry and Ayrton.
Zn	Pt	0·984	0·984	0·881	0·981
Cu	Pt	0·184	0·184	0·367	0·238
Fe	Pt	0·384	0·312	0·704	0·369

So that, although Exner gives as his reason for his making the above experiments, that the results of all experimenters since Kohlrausch's time are isolated and unreliable, it would seem that the consistency of these three series of determinations with each other, and their inconsistency with his new measurements are such as to make us reject his statement even as an empirical law. The authors then take up Exner's crucial experiment, to show that two plates of silver, one in an atmosphere of chlorine and the other in an atmosphere of oxygen, but in metallic connection with one another, show a difference of potential. They point out that if this experiment had been properly performed it would have corroborated the result arrived at by Mr. Brown of Belfast, which in no way contradicts the contact theory, since every adherent of the contact theory recognises a difference of potential between a metal and an oxide or chloride or any other salt of the metal, either in the wet or dry state. But Exner's experiment was carelessly performed, as instead of a metallic contact between a platinum wire used in the experiment and the silver plates there must have been a layer of chloride of silver between the metals.

In another of Exner's papers he states that the contact theory requires the E.M.F. of a Smee's cell to be at first 0·732 Daniell, and then to become less, and that the E.M.F. depends on the negative metal; whereas the chemical theory gives a much greater E.M.F. at the beginning if the liquid is oxygenated, and it can never become less than 0·732 D if zinc is prevented from being deposited on the negative metal. Many previous experimenters had proved that the latter statement is the true one, and its truth is shown by Exner's new experiments, which further show that whatever be the negative metal the E.M.F. must be the same. The authors point out that Exner's statement as to what the contact theory requires in a Smee cell is quite gratuitous, and indicates that he is not at all acquainted with the contact theory; they show that the sum of the contacts for a Smee cell published by them in the *Transactions* of the Royal Society, gives an E.M.F. greater than that of a Daniell. They quote also from Sir W. Thomson's well-known paper in the *Phil. Mag.* of 1851 as complete a statement of what goes on in a Smee cell; of its primary E.M.F. being as much as 2½ Daniell's; of its *working* E.M.F. being what Exner says it is; as if Exner and all his predecessors' experiments on Smee's cell had been perfectly well-known to Thomson thirty years ago. Thomson, however, did not know that the nature of the negative metal is indifferent. This appears to be the only new fact given us by Professor Exner, but unfortunately for him it has been disproved by the more careful experiments of Beetz, who gives the following results for various

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,325	300	—	Victoria Docks.
Henley's	ss Caroline	526	70	—	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	London.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Algiers.
Telegraph Construction	ss Edinburgh	2,315	275	J. Seymour	Victoria Docks.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	—	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	A. Killett	Victoria Docks.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Canadian Government	ss Newfield	785	90	R. A. Guildford	Canada.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	*ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Canea.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	—
Telegraph Construction	twin screw Scotia	4,667	550	W. R. Cato	—
Telegraph Construction	ss Seine	3,579	500	H. Manning	Victoria Docks.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	—	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.

* This vessel sails under the French flag.

cells, dilute sulphuric acid being the liquid, zinc being the positive metal:—

Negative metal.	E.M.F. of cell at first.		E.M.F. of cell after being closed some time.
Platinum	1·52	.....	0·72
Copper	0·98	.....	0·46
Silver	1·23	.....	0·51

When sodium amalgam is the positive metal the difference is even more striking:—

Negative metal.	E.M.F. at first.		E.M.F. after being closed some time.
Platinum	2·31	.....	1·33
Silver	2·05	.....	1·22
Copper	1·79	.....	1·14
Zinc	0·78	.....	0·68

Into Exner's disputes with German physicists as to the meaning of the term polarisation the authors do not enter; for although Exner uses strong language concerning the methods of other experimenters, and the quarrel seems to him an important one, it is not of much interest in this country, and it has no bearing whatever on the dispute between the contact and chemical theories. The authors incidentally referred to the complete disproof of the results of Exner's experiment on thermo-electricity given lately by Professor Young, of Princeton.

THE PHYSICAL SOCIETY.—Nov. 13, 1880.

The Nature of Beats in Consonance.

Mr. Bosanquet, of St. John's College Physical Laboratory, Cambridge, read a paper on "The Nature of the Sounds which Occur in the Beats of Consonance." From sustained octaves and twelfths he found that, when the beats of the harmonics are cleared away, each beat consists entirely of variations in the intensity of the lower notes. He gave the mathematical theory of these beats, and likewise of the curves given by the harmonograph. He also described an ear tube for using in connection with a resonator. It is difficult to get definite results with a resonator unless the passage from the latter to the ear is closed to sound. The ear tube consists of a copper pipe bent into a sickle shape to gird the face, so that the ends may enter the ears, into which they are screwed, plugging them close. The sound is led from the resonator to the middle of this bent pipe by a flexible india rubber tube, and thence to the ears.

Action at a Distance.

Mr. Brown read a paper on action at a distance. He drew attention to the fact that though Newton disbelieved in action at a distance he did not pronounce whether the medium was material or immaterial. Mr. Brown showed that the hypothesis of a material medium was encumbered with difficulties, since, among other reasons, direct contact could not explain gravity; projection of small particles from one body to another could not explain attraction; and Le Sage's theory of corpuscles (as modified by Mr. Solver Preston) required an enormous degree of porosity in masses of matter. The nature of magnetism and vibration was also discussed by the author.

Forces Called Attractions.

Mr. J. Macfarlane Gray read a paper on "The Mechanical Nature of the Forces Called Attractions," and gave grounds for attributing them to the pressure of a universal material ether of a gaseous nature.

Contact Electricity.

A full abstract of this note, by Professors Ayrton and Perry, is given in another column.

A New Photo-electric Cell.

Professor Minchin, of Cooper's Hill Engineering College, exhibited a new photo-electric cell. This consists of a vessel of water containing a little acid, carbonate of calcium and two tinfoil plates. When a beam of lime light was allowed to fall on one of the plates a powerful current was set up in the cell, as seen by the deflection of a galvanometer connected in circuit with the plates. When a red glass screen intercepted the beam the effect was very slight. Professor Minchin had begun his experiments with fluorescence, but found "hard" water containing this salt of lime does equally well. The cell possesses this advantage, that the current it gives soon decreases in the light. When first the light falls on it the exposed plate is positive, but it soon changes to negative. Professor Minchin had tried the cell in place of a selenium one in the photophone, but with unsatisfactory results.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Nov. 17.			Business Done Week Ending Nov. 17. Highest.		Lowest.
Anglo-American Ordinary	61¼,	¼	.....	62	.....	61
Do. "B"	91½,	92	.....	92½	.....	91½
Do. "A"	32,	¼	.....	33	.....	31½
Brazilian	9 13-16,	15-16	.....	10	.....	9½
Cuba	8½,	9½	.....	—	.....	—
Do. Ten per Cent. Pref.	16,	½	.....	16½	.....	16½
Direct Spanish	2¾,	3¼	.....	3 3-16	.....	3 3-1
Do. Ten per Cent. Preference	12½,	13	.....	—	.....	—
Direct United States	11¾,	12	.....	12	.....	11¾
Eastern	9½,	¾	.....	9¾	.....	9¼
Do. Six per Cent. Debenture	103,	106	.....	104	.....	104
Do. Five per Ct. do. 1899	103,	105	.....	105½	.....	105½
Do. Six p Ct. Pref	12½,	¾	.....	12¾	.....	12¾
Eastern Extension	9 15-16,	10 1-16	.....	10½	.....	9 15-16
Do. Six per Ct. Deb	108,	111	.....	—	.....	—
German Union	9¾,	10¼	.....	10¼	.....	9¾
Globe Telegraph & Trust	6½,	¾	.....	6¾	.....	6 9-16
Do. Six p Ct. Preference	12,	½	.....	12½	.....	12
Great Northern	10¼,	¼	.....	10¼	.....	10¼
Indo-European	24,	25	.....	—	.....	—
Mediterranean Extension	2¾,	3¼	.....	2 13-16	.....	2 13-16
Do. Eight p Cent. Pref	10¾,	11¼	.....	—	.....	—
Reuter's	11,	½	.....	—	.....	—
Submarine	250,	260	.....	258	.....	257
West India and Panama	1½,	½	.....	1 7-16	.....	1 5-16
Do. Six per Cent. 1st Preference	6½,	¾	.....	6¾	.....	6½
Western and Brazilian	8½,	¼	.....	8¾	.....	7¾
West. Union 7 p. Ct. 1st Mt.	118,	122	.....	—	.....	—
Do. Six per Ct. Sterg.	104,	—	.....	104½	.....	104½

TRAFFIC RECEIPTS FOR OCTOBER, 1880.

Companies.	Oct., 1880.	Oct., 1879.	Increase.	Decrease.
Cuba Submarine Company	2,100 estd.	3,51	—	1,41
Direct Spanish Telegraph Company	1,821	1,370	451	—
Eastern Telegraph Company	47,570	50,251	—	2,681
Eastern Extension Telegraph Company	29,061	31,419	—	2,35

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ABSTRACTS OF SPECIFICATIONS.

—o—

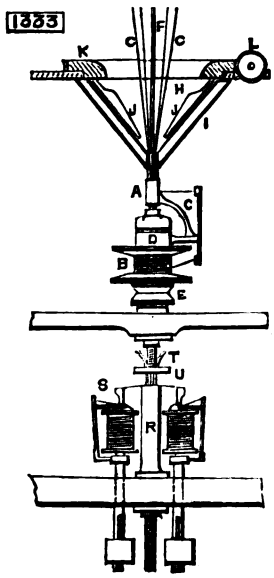
[*We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts*—ED. *E.*]

1295. INSULATING ELECTRICAL CONDUCTORS, *E. M. Allen.—Dated 30th March*, 1880.—(*A communication*). 6*d*.

The wire is covered with a fibrous material in the usual manner, and then passed through a composition kept in a liquid state by heat, and consisting of native bitumen and parafin oil, candle tar, or residuum of petroleum.

1333. MACHINERY FOR THE MANUFACTURE OF ENGINE PACKING, INSULATED TELEGRAPH WIRES, &c., *G. F. James.—Dated 31st March*, 1880. 6*d*.

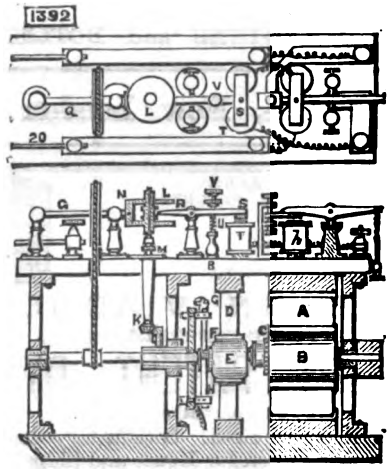
This invention has for its object both the lapping and braiding or plaiting of any desired number of threads or strands or series of laps or braidings round any desired central core in one and the same machine, and consists in so arranging the lapping spindles and the braiding spindles in the same framework, and by preference to revolve round the same axis, that the core, say, after being lapped, is then taken through one or more series of braiding spindles, which braid a corresponding number or coatings of braid upon such lapped material. In order to lap and braid or plait any number of threads or series of laps or braidings round any central core, a lapping spindle, A, is employed, consisting of a bobbin, B, and flyer, C, both revolving round a hollow spindle, D. Through this spindle passes the central core, F, surrounded by yarns, G. The lapped material then passes through the hollow spindle R, and is subjected to the braiding action of the braiding spindles S, and, if desired, additional yarns, T, may be introduced between the lapping and braiding operation, such



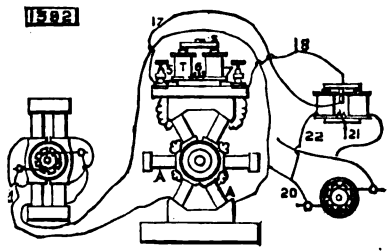
yarns passing through a guide piece, U. The hopper, H, for containing china clay or other lubricating powder or liquid is provided with an outer casing, I, through which steam circulates to keep the contents in a heated and, if required, also liquid state. Stirrers, J, are mounted on a worm wheel, K, driven by a worm, L, to agitate the contents of the hopper. The finished work is drawn off upon a creel or cylinder, first passing over pulleys. The inventor claims, first, combining lapping and braiding spindles in one and the same machine, substantially as and for the purposes hereinbefore described and illustrated on the accompanying drawing. Second, the improved arrangement and construction of the hopper or funnel and mechanism for stirring and agitating the contents of the same substantially as and for the purposes hereinbefore described and illustrated on the accompanying drawing. Third, the improved drawing off mechanism, substantially as and for the purpose hereinbefore described and illustrated on the accompanying drawing.

1392. IMPROVEMENTS TO DYNAMO-ELECTRIC MACHINES.—*W. R. Lake* (*A communication from H. Maxim*).—*Dated 5th April*, 1880.

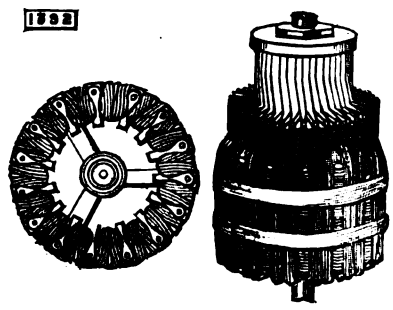
The inventor aims to regulate the generation of electricity, to obviate the heating of the machine, and to improve the commutator. For the first of these purposes an auxiliary machine is used to excite the main field magnets, and a sensitive electro-magnet controls mechanism which turns the brushes of the auxiliary machine to and from the neutral points of their commutator. To minimise heating the armature is considerably divided, so as to have no unbroken mass of iron or wire at any point, and the commutator plates are of such form as to be parallel to the axis of the cylinder on the inside, and take the direction of a double spiral on the outside. In the following diagrams Fig. 1 is a plan of the top



of the machine. Fig. 2 a section near the centre. Fig. 3 shows the connection of the wires. Fig. 4 shows the method of winding the coils, and Fig. 6 is an end view of the armature. A A are the electro-magnets, B the revolving coils, C the commutator of the main machine. The electro-magnets of the auxiliary machine are shown at D D, its coil at E, and commutator F. G G are the brush holders, and H H are brushes. The toothed sector I engages the bevel wheel K on the shaft M, carrying a double disc, L L, which can move through a short distance vertically. N, on the shaft Q, can thus be made to engage either side of the disc L. The shaft Q is driven as



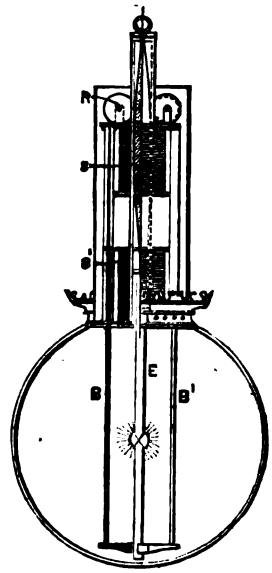
shown in the figure. The lever R regulates the position of L, and this lever is actuated by the electro magnet T. The uses of the spring U and screw V can easily be seen. A second electro-magnet, *h*, with its connections is shown. The current from the auxiliary passes through a shunt or through T to the main field magnet, and then back as shown in Fig. 3. When the shunt 17, 18 is open, the current goes from 1 to 16 inclusive, but when closed T is cut out of the circuit, and the current follows 17, 18 instead of 5, 6, 7. The opening and shutting of the shunt is effected by the magnet H, with its armature and lever placed in branch 20, 21, 22. The position of the shunt determines the condition of T, and so of S, the



lever R, and disc L, which when depressed engages friction wheel, N, and the mechanism is so arranged as by this means to alter the position if the brushes are required. The inventor makes numerous claims (1) the combination of the two machines as described, (2) the regulating mechanism and magnets, (3) the armature which will be understood from the diagram, (4) the double-spiral commutator, &c.

1397. ELECTRIC LAMPS, &c., *C. D. Abel.—Dated 6th April*, 1880. (*A communication.*) 6*d*.

The inventor's desire is to effect automatically the regulation of the distance of the carbons in an electric lamp without the aid of clockwork mechanism by using solenoids. He uses two solenoids, one of low resistance in the lamp circuit, the other of high resistance in a branch circuit. The core is shaped like a double cone, &c., to remain stationary so long as the two solenoids exert equal attractive forces. Thus, a double coned core, F, is free to move within the two solenoid coils S S^1. The coil S of large wire presenting small resistance is in the circuit of the carbons, and S^1 in a shunt circuit of fine wire in many convolutions, so as to get with a weak current magnetic force, equivalent to that of S with a strong current, and to present considerable



resistance. When the carbons are too near, the the attractive power of S being increased while that of S^1 is diminished, the core F is attracted upwards, separating the carbons. When, on the other hand, the carbons are too far apart, S loses force and S^1 gains force, so that the core F is attracted downwards, causing the carbons to approach. In the drawing the core F and upper carbon E with its socket are balanced by the lower carbon E^1 and the rods B B^1 which carry it: the pulleys R, over which pass the balancing cords, serve as guides to the socket tube of the upper carbon. The inventor claims (1) the use of solenoid cores with the metallic mass of which they consist lessened towards each end; (2) the combination of cores with the two solenoid coils.

1407. IMPROVEMENTS IN ELECTRICAL CONDUCTORS AND IN THE ARRANGEMENT AND MANNER OF USING THEM.—*G. O. Heaviside. Dated 6th April*, 1880. 6*d*.

The object of this invention is to neutralise the inductive effects acting on adjacent wires. For this purpose two insulated conductors are used for the circuit, one inside the other. Fig 1 shows a section of this invention, in which A represents the line wire, B the insulation of A, while C is another conductor, such as foil or brass wire again covered with the insulating material D

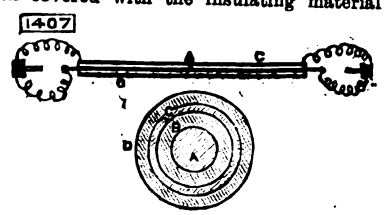


Fig. 2 shows one of the ways of using this compound conductor. The circuits with ordinary wires are rendered mutually independent by arranging the line and return wires of the various circuits that the resultant induction action is *nil*. The inventor claims the described arrangement in electrical conductors, and the arrangement whereby mutual actions neutralise each other.

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ESTABLISHED 1851.

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SLIP

TELEPHONY IN AMERICA.—The Klemm Telephone Company has been incorporated with a capital fixed at 1,000,000 dols.

THE NEW FRENCH CABLE.—We are informed that faults exist in the lines between St. Pierre and the American shore.

THE ANGLO-AMERICAN COMPANY.—This company has paid the dividend about which one solitary shareholder was so exercised in mind.

GLASGOW.—Mr. Swan is to describe and exhibit his lamp to the members of the Philosophical Society of Glasgow during this winter session.

THE GOWER TELEPHONE.—One of the largest railway companies is about to introduce this instrument as part of the signalling arrangements.

DECEASED.—Nov. 4, at Pietermaritzburg, South Africa, Edward J. James, Government Telegraph Department, fourth son of H. James, Esq., of Southport.

JAPAN.—The American papers state that a telegram from Yokohama says it is reported that the Japanese Government intends to lay a cable between Nagasaki and Fusan.

MR. EDISON'S LAMP.—The Patent Museum, South Kensington, now contains Mr. Edison's "original lamp," accompanied by a certificate stating that it burnt for 1,390 hours.

EDISONIA.—The stockholders of the Edison Electric Light Company received a circular the other day assessing them 60 dollars a share, to meet the expense of recent experiments. —*Operator.*

MEXICO.—A concession has been granted to a company for making 1,300 miles railroad, with a telegraph line from the city of Mexico to the frontiers of the United States and to the Pacific Ocean.

LIGHTNING CONDUCTORS ON BOARD MEN OF WAR.—We understand that instructions have been given that all lightning conductors on board Her Majesty's ships are to be regularly tested.

THE ELECTRIC RAILWAY.—This new wonder of the age, says the *Standard*, will be first seen in Berlin. Messrs. Siemens have obtained a concession for a suburban line from Lichterfeld to Teltow.

CYPRUS.—The report of "Her Majesty's High Commissioner" states that, "Contrary to my expectations, the latter (the telegraph) is being used by the public far more than I thought it would."

THE PHOTOPHONE.—Prof. Graham Bell will read a paper on his latest discovery on December 1st to the members of the Society of Arts. Mr. F. J. Bramwell, F.R.S., will preside. The lecture commences at eight o'clock.

EDISON'S TELEPHONE.—We understand that the "grinder" telephone is not giving satisfaction, and that in many instances a Bell telephone has been substituted as the receiver, in consequence of complaints from renters.

ERRATUM.—In M. Hospitalier's letter in our last issue read Peclet for Pielet; 350 for 390, and

$$\frac{37462}{75} \text{ for } \frac{37462}{79}.$$

THE TELEPHONE IN GERMANY.—The Berlin *Post* announces that it is about to seek parliamentary authority for connecting the editor's room directly with the Chamber of Deputies by means of a telephonic system.—*La Lumière Electrique.*

HULL.—The good people of Hull last session obtained an Act of Parliament authorising them to supply the "electric light." One gas company has reduced its rate to 2s. 3d. per 1,000 cubic feet; the other two companies continue obdurate. Advice gratis:—Better swallow a mouse than a mountain.

TIME SIGNAL.—The time ball on the Broadway tower of the Western Union Telegraph Company's building is dropped at New York, noon (12h. 0min. 0sec.), by the standard time of the United States Naval Observatory at Washington. New York is east of Washington 0h. 12min. 10·37sec., New York is west of Greenwich 4h. 56min. 1·65sec.

NOTHING NEW.—The wires stretching across the road in connection with the telephones recently adopted by the Monk Bridge Iron Company, Leeds, were recently caught by a fire-escape with so much force as to bring down a chimney-stack to which the wires were attached, and considerable damage was also caused to the roof of the building.

INDUCTION AND THE TELEPHONE.—According to the *Daily News* a highly important discovery has been made by a firm in Neuchatel. They have devised a means of completely preventing the induction of the electric current from one wire to contiguous wires. This invention will greatly promote the efficiency of the telephone and extend its use.

ELECTRIC RAILWAY IN ITALY.—The suggested use of electricity for the purposes of railroad locomotion is finding great favour in Italy. An experiment has been tried at Turin with very satisfactory results. Hydraulic force was in this case used for producing the electricity which was transmitted by means of two parallel metallic cables along the route.—*La Lumière Electrique.*

INDIA.—The statistical abstract relating to British India informs us that India had in 1879 a length of 18,589 miles of telegraph line, with 44,470 miles of wire, also 108 miles of cable. The total number of messages during the year was 1,379,312, exclusive of service messages. Of these 1,158,870 were private, 212,851 State, and 7,591 Press messages. The receipts were £353,741 and the total expenditure £357,649.

TASMANIA.—The recently-published statistics for 1879 of this colony show that the colony possesses 731 miles of line, with 949 miles of wire, connecting 62 stations. The number of persons employed is given as 79. The number of internal messages for the year was 74,810, of external 14,022, or a total of 88,832, giving a revenue of £4,225 2s. 5d., with an expenditure of £6,148 2s. 7d. This expenditure does not include the subsidy of £4,200 on account of the submarine cable.

ONE TREE ISLAND.—In our note on "A Soliloquy to a Thomson Recorder," the island of St. Pierre is dubbed the "stony isle." It is also known by another name, "One Tree Island," as containing one, and only one "tree," to be found in the garden of the "Governor." Once a year the inhabitants make a kind of pilgrimage to the governor's house, of course ostensibly to pay their respects to this functionary, but primarily for the privilege of admission into the garden to see the "solitary tree."

FRENCH OPINION OF MR. SWAN'S LAMP.—*La Lumière Electrique* reminds its readers of its oft-repeated charges against Mr. Edison's lamp that the idea had been forestalled by, if not copied from, Mr. Swan. Mr. Swan's recent lecture affords some occasion for rejoicing at the confirmation contained therein of its opinions, and although refraining from expressing any definite views with respect to the practicability of subdividing the light indefinitely, *La Lumière* speaks very highly of our countryman's labours.

THE EDISON ELECTRIC LIGHT COMPANY.—At the annual meeting of the stockholders of the Edison Electric Light Company, held on the 11th November, the following trustees

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were elected:—Norvin Green, Tracy R. Edison, Robert M. Gallaway, James H. Banker, E. P. Fabbri, Nathan G. Miller, Robert L. Cutting, jun., G. P. Lowrey, James O. Green, José F. de Navarro, Thomas A. Edison, Henry Villard, and Lewis Roberts. Of the 3,000 shares, 1,060 were voted upon for the above ticket. There was no opposition.

Postal and Telegraph Employés.—A somewhat angry correspondence is going on in the columns of the *Civilian* between members of these Departments as to the relative amount of hard work performed by each. The worthlessness of comparisons of this sort will be seen from the fact that one party is spoken of as merely "sitting on a stool," and the other as "dragging letter bags about." These disputants had better each stick to his own last. If one has a grievance the worst way to get it rectified is to protest that nobody else has any.

Sale of a Battery.—In the science column of a contemporary, and under this heading, particulars are given of the sale of a "battery" begun in 1843 by the late Robert L. Stevens, of Hoboken, and just now knocked down to a builder in New York for the sum of 55,000 dols. It cost 2,000,000 dols., and 500,000 dols. more are required to finish it. We take leave to suspect that the New York builder has an eye to warfare rather than to science—a floating battery of so many guns, not a galvanic battery of so many cells, being probably what is meant.

Police Telephones.—Chicago leads the way in adopting telephones for general police uses. Experimental telephonic stations have been established at various points in one important district, and relays of mounted officers are kept in waiting at a central station. Reliable citizens are furnished with keys to the telephone boxes nearest their residence. To prevent false alarms the keys are numbered, and cannot be withdrawn from the lock until released by a key carried by the policeman on that beat. When anything goes wrong in a district, the alarm is sent to the central station, and explanations are given through the telephone. In case of serious disturbance a large bell is sounded, and every officer on post runs to the nearest box to receive orders.

Fire Caused by an Electric Light Wire.—Does any electrician believe the following statement in a letter to the Editor of the *Scientific American*:—"I venture to call your attention to an occurrence which took place at No. 4, Maiden-lane very recently. In the office of Messrs. Silcox and Co., No. 4, Maiden-lane, is a telephone communicating with their factory, No. 14, Maiden-lane. One day, either Monday or Tuesday last, some person on the roof of one of the intervening buildings dropped an *electric light* wire upon that of the *telephone* wire of Messrs. Silcox, bringing the two wires in contact. The effect rather astonished the people in the office. Flames burst forth from the telephone instrument on the wall, producing such an intense heat as to entirely destroy the magnets. Can you, through your valuable journal, give us a possible reason for this? Suppose the same thing should occur at Ridley's, or Lord and Taylor's, or any other establishment having telephones. In most of these establishments there is a large amount of open stock lying and hanging in every direction. It occurs to *us* that if there is a danger of similar accidents in these stores, it it will be apt to throw the *show window* fire traps into the shade.—Jas. Harrison, Superintendent Bureau of Surveys, New York Board of Fire Underwriters, No. 115, Broadway, New York, October 21, 1880."

The Press and the Telephone Law-suit.—Commenting upon the forthcoming action of the Government against the Telephone Companies, the *Examiner* remarks, with reference to the scientific aspect of the dispute:—"It happens that the telephone has acoustical properties as well as electrical. Any definition of it, therefore, by an expert will be coloured very much by whichever characteristic he chooses to dwell upon most. From one point of view Professor Bell's and Mr. Edison's devices are mere varieties of magneto-electrical and chemico-electrical appliances, from another they are simply very ingenious speaking-trumpets. The one question which concerns the general public, however," continues our contemporary, "is whether communication by telephone is in future to be left to unrestricted competition or whether it shall be regulated, like the telegraphs, by the State. The friends of the companies allege that the cost of payment for a licence would fall upon the customers. On the part of the Government it is urged that unrestricted competition has hitherto ended in gigantic private monopolies, far more burdensome than if wielded by the State, and that the earnings of the companies are partly extracted from the public pocket to pay dividends, and partly diverted from a legitimate channel of national revenue. The cost of determining these issues will probably be enormous, and whoever has caused them to be raised in a court of law has incurred a very grave responsibility."

Suggestions to the Chinese.—The following is an extract from a paper of advice on military questions drawn up by Colonel Gordon for the use of the Chinese Government:—"The Chinese should make telegraphs in the country as a rule, to keep the country quiet and free from false rumours, but with the Chinese soldiers in the field they should use sun-signals by means of the heliograph. These are very easy and can do no harm. For this purpose a small school should be established in each centre. Chinese ought not to try torpedoes, which are very difficult to manage. The most simple torpedoes are the best and the cheapest, and their utility is in having many of them. China can risk sowing them thickly; for if one of them does go astray and sink a Chinese junk, the people of the junk ought to be glad to die for their country. If torpedoes are only used at certain places, then the enemy knows that he has to look out when near these places; but when every place may have torpedoes, he can never feel safe; he is always anxious; he cannot sleep; he gets ill and dies. The fact of an enemy living in constant dread of being blown up is much more advantageous to China than if she blew up one of her enemies; for anxiety makes people ill and cross. Therefore China ought to have cheap, simple torpedoes which cannot get out of order, which are fired by a fuze, *not* by electricity, and plenty of them. She ought not to buy expensive complicated torpedoes."

Heliographic Signalling. — Heliographic signalling, which is likely to be much used in future wars, is, after all, not such a modern invention as it has hitherto been held to be. We learn that this science of utilising the light of the sun for transmitting messages as quickly as the telegraph—without, however, being liable, like the latter, to be cut by hostile forces, for the heliograph signals over the heads of the enemy—was practised at least as early as the commencement of the sixteenth century. According to a ballad as old as 1511, some kind of heliograph was used in the fight between the "Great Harry" and its consort, under Lord Howard, on the one side, and the "Lion and the Union," under Sir Andrew Barton, of Scotland, on the other. Lord Howard is represented as having met at Thames mouth a merchantman which had been plundered by the Scotch admiral, and the captain offered to sail back with him and assist in the forthcoming fight if he were armed with a few pieces of

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ordnance. He was also to signal to the English admiral when he made out the enemy, by means of a "glasse," and it is clear from the account given of it that it was some sort of heliographic signal, for the ballad says:—

"The merchant set my lord a glasse
Soe well apparent in his sight,
And on the morrow by nine of the clock,
He showed him Sir Andrew Barton, Knight."

If the real credit of the invention of the heliograph does not belong to this brave merchant captain, Henry Hunt, he certainly used a common means of signalling understood among all sailors more than four hundred years ago.—*Iron.*

THE NINE ELMS ACCIDENT.—In his report on this accident Major Marindin, by inference, strongly advocates electric automatic apparatus as an auxiliary to the existing signal systems without it. He says:—"The best remedy for accidents such as this, arising from a failure of block working on account of mistakes, to which all men are liable, would be the adoption of some mechanical contrivance which would render such mistakes harmless; and it is to be hoped that the results of this, and of the other collision to which I have referred, will induce railway companies to give their careful consideration to this question. In this instance it would be perfectly easy, by an adaptation of such a system of electrical interlocking as that in use upon the London, Chatham, and Dover Railway and the Metropolitan District Railway, to make it impossible for the signalman in this cabin, after having lowered the signal arm on the down home signal post for a light engine going to the locomotive yard, to lower this signal again, or to lower the main line down signals, until the points had been set and this signal had been restored to its normal condition. I would urge the company, therefore, if they are not prepared to adopt the electrical interlocking above recommended, and if it be impossible to improve the existing state of affairs by arranging so that these light engines may get to the locomotive yard by an independent line, to consider the question of moving the signal cabin, and in the meantime to issue an order that the firemen of engines passing this cabin to go forward to the junction are to wait by the cabin as a precaution against their engines being forgotton until the signalman has set the points and lowered the proper signal, joining their engines when they are coming back along the siding past the cabin."

WESTERN UNION TELEGRAPH COMPANY.—Our American contemporary, the *Journal of the Telegraph*, commenting on the annual report of this great company, says:—"The revival of the business of the country which commenced in 1878 very speedily showed itself in the rapidly increasing demand for telegraphic service. It soon became evident that large additional facilities must be furnished, and this has been done as fast as they could be provided. Accordingly, during the last fiscal year, 2,658 miles of pole lines and 21,968 miles of wire were erected by the company, much the largest construction in any year in its history. Besides these, in the three months which have elapsed since the close of the fiscal year, 1,300 miles of pole lines and over 9,000 miles of wires have been added to this total of construction; and the work is still continued and new lines are being constructed as rapidly as possible. The growth of the business and of the increase of the facilities of the company are strikingly shown by a comparison of the figures of 1866 and 1880. In the former year (the first after its consolidation with the United States and the American Telegraph Companies) the company owned and operated 75,686 miles of wire. In 1880 these had increased to 233,534 miles, and the additions since made bring the total up to nearly 250,000 miles. In 1866 there were 2,250 offices, and on June 30th, 1880, 9,077. The number of messages transmitted has within the same time increased from 5,872,282 to to 29,215,509 per annum, and its receipts from 6,568,925·36 dollars to 12,782,894·53 dollars. The increase of the last fiscal year over that of the preceding year was 2,658 miles of pole lines, and 21,968 miles of wire, as before stated; 543 offices, 4,145,403 messages transmitted, 1,659,197·08 dollars gross receipts, and 876,861·12 dollars net earnings. Notwithstanding the necessarily increased cost of doing the business, the ratio of expenses has been reduced to 54 3-10 per cent. of the receipts, against 56 2-10 the previous year, and 63 9-10 the year preceding that."

ELECTRICITY IN COLLIERIES.—In his recent letter to *The Times* Mr. W. H. Preece pointed out that lightning was probably the immediate cause of some colliery explosions, and alluded to the Risca explosion as a case of the kind. His statements were criticised by Colonel Shakespear, and in reply to this criticism Mr. A. H. W. Radcliffe has written as follows to the *Colliery Guardian*:—"Absence from home during the whole of last week prevented my earlier answering Colonel Shakespear's letter in your edition of the 6th, and as I am the Mr. Arthur Radcliffe alluded to by Mr. Preece (in his letter to *The Times*) as having investigated the matter of the Risca explosion on the spot, I feel called upon to respond to Colonel Shakespear's query as to why a discharge of lightning, assuming it struck the head-gear, should prefer to take the course down the shaft in preference to the mass of metal in the engine house. In the first instance, the engine is generally well insulated by having a solid bed of masonry or concrete as its foundation. In addition to this, at Risca the engine house is built on the side of the mountain, which is almost wholly composed of stone. At all events, wherever the soil has slipped or been removed near the spot, scarcely anything but stone is apparent. And my experience as telegraph engineer for the Monmouthshire Railway Company, which runs by the colliery and through the adjacent valleys, has shown me the difficulty of obtaining what is technically known as 'good earth' in such ground. In many places in the neighbourhood I have had to carry my earth wires several hundred yards; therefore, it is only reasonable to assume that the conducting ropes and rods down the shaft, terminating in long lengths of metal rails, would afford a better channel for escape than the mass of insulated metal in the engine house. With reference to Colonel Shakespear's further remarks as to the engineman not having spoken on the subject, he did so on the day of the explosion; he said a flash appeared to strike the building, and a few seconds afterwards the explosion occurred. Whether this flash caused the explosion or not is a matter that must now be one of opinion only. Mr. Preece's object in writing his letter was merely to call attention to a very possible source of danger, which could only be avoided by having the head gears of collieries thoroughly protected by lightning conductors—not such as are usually fixed by rule of thumb—the end of the rope simply buried in the ground, regardless of the nature of the soil—but by conductors efficiently fixed and electrically tested. In vindication of the theory I propounded to Mr. Preece, and which produced his letter, I may say I had it personally from one of H.M. inspectors of mines that a manager of a colliery mentioned to him that some of his men have been very much alarmed at seeing a flash of lightning on the metals underground during the time a storm was raging overhead. What would have been the result in that case had there been gas present?"

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

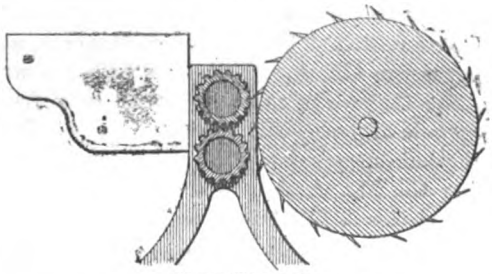
BY THOMAS BOLAS, F.C.S.

LECTURE VI.—DELIVERED MARCH 8, 1880.

(CONCLUDED FROM PAGE 5.)

The next process, known as ticking, consists in chopping up the softened gutta, and allowing it to fall into hot water; this operation, together with agitation in hot water, being repeated until the material is rendered fairly free from foreign matter. The ticker is represented by the diagram now on the screen (Fig. 33), and consists of a hopper, shown on the left-hand side of the diagram, and a pair of fluted rolls, which lead the soft gutta towards a rapid rotating wheel, which latter has a series of blades

FIG. 33.

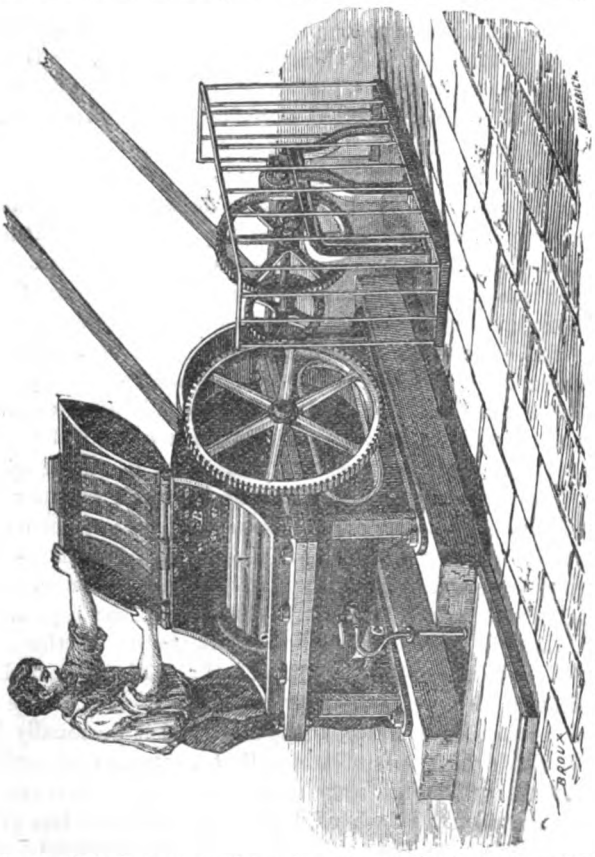


THE TICKER.

or cutters attached to its circumference, and these chop off the gutta in flakes, which fall into hot water. On the table are samples of gutta in its various stages of preparation, these having been kindly lent by the Gutta-percha Company. The material having been ticked and washed sufficiently, can be rolled into sheets at once, but it is usual to both masticate and strain the material when the highest degree of uniformity in texture, together with freedom from foreign matters, is desired.

The masticator employed (Fig. 34,) is similar in principle to that used in treating rubber; but its design is lighter,

FIG. 34.



THE MASTICATOR FOR TREATING GUTTA PERCHA.

as the work it has to perform is comparatively easy, and Pfleiderer's kneading machines (Figs. 11, 12, 13, 14, p. 190, vol. V.) have been found very well suited for the mastication of gutta percha. Arrangement employed for straining the gutta percha consists of an iron cylinder, in the lower portion of which are placed strainers of iron wire, netting or gauze. The cylinder having been heated by means of steam. and filled with the soft gutta, a tightly fitting piston is forced into the upper part by means of hydraulic power, and the gutta is naturally forced out through the wire gauze. A second mastication, after the straining, is sometimes considered advisable.

Very many materials, such as lac, pitch, plaster, magnesia, clay, and other earthy substances, are occasionally incorporated with gutta percha, in order either to harden it, cheapen the material, or to adapt it to special uses; and elastic glue, compounded of gutta percha, resin, and pitch, forms a very useful cement in some cases.

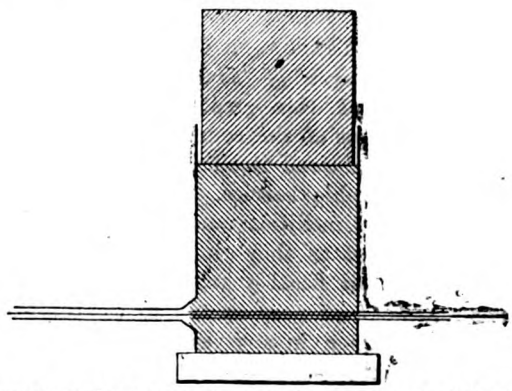
Mixtures of india rubber and gutta percha are useful in many instances, and a vulcanite, having as its base equal proportions of rubber and gutta, possesses some very excellent qualities as a material for making buttons and other small articles.

As a moulding material, gutta percha stands pre-eminent. A copper printing plate can be moulded so perfectly in the material, that an electrotype made on the gutta percha mould yields prints indistinguishable from those taken from the original plate. Again, photographic reliefs may be most perfectly moulded in gutta; and dentists largely make use of it for obtaining casts of the interior of the mouth.

When a strip of gutta percha is stretched by a sufficient force to about double its length it is found to have acquired a fibrous texture, and to be capable of resisting a much greater strain than that which served to extend it. This can, as you see, be very well illustrated by stretching one-half of this strip.

The use of gutta in covering electrical wires and cables is probably its most important application to the requirements of modern civilisation; and numerous specimens, lent by the Silvertown Company, Messrs. Rickards, of Derby, and others illustrate these uses. It will, doubtless, interest you to see some illustration of the method employed in covering wires with gutta percha. Here is a small metal cylinder (Fig. 35,) which is now full of soft gutta percha, and a solid metal plunger or piston fits into the cylinder with tolerable accuracy. In the front (on the left-hand side of the diagram) there projects a short tube, the internal diameter of which serves to gauge the external size of the coating on the wire; while opposite it a tube of much smaller diameter passes right through the cylinder and mouths, near the inner extremity of the first-mentioned tube. A piece of wire being now slowly drawn through the apparatus (in the case of the diagram from right to left), the plunger is forced down by means of a small press; a tube-like coating of gutta is thus, as you see, forced out around the wire. In the industrial production of the beautifully coated wires you see before you, very complex and finely adjusted machinery is made use of, but the general principle is the same as you have seen illustrated.

FIG. 35.



APPARATUS TO ILLUSTRATE THE COVERING OF WIRES WITH GUTTA PERCHA.

Photographic baths, dishes, cisterns, and other similar articles, can be readily made out of sheet gutta percha; the edges to be united being softened by a gentle heat, but these articles are generally not equal to similar vessels of ebonite. Gutta percha, however, has the advantage of being very easily workable.

Sound conductors, or speaking tubes, made of gutta percha tubing, are singularly effectual, and are largely used in warehouses, and other places.

Rolled or calendered sheets of gutta percha are largely employed—the thick sheets being used for soling boots and such-like purposes, while the extremely thin rolled sheet, which rivals

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paper in tenuity, finds many uses. As a coating for damp walls it is most effectual, while as a waterproof material for certain surgical purposes it is unrivalled; and for covering over joins in telegraph wires it receives extensive application. No doubt most of you have seen telegraph workmen operate with this material in the streets of London; wrapping it round and round the joint, and at the same time softening it by means of a lamp. The large pieces of thin sheet hanging up have been lent by the Gutta Percha Company, and there are also some interesting specimens, for which I am indebted to Mr. Walter Hancock. Please notice the difference between the thin sheet made from gutta percha which has been masticated and strained, and that which has not been masticated. The masticated sheet shows no texture; while that which has been strained but not masticated is paler in colour, and shows a kind of grain or texture, which causes it to split more readily in a longitudinal than in transverse direction. Some of these samples, lent by Mr. Hancock, are of interest, as being no less than twenty years old, a great age for gutta percha thin sheet.

Gutta percha tubes are manufactured by the squirting process, already referred to several times; and they are of considerable use for making syphons, or conducting tubes intended to convey corrosive liquids. Pump buckets of gutta percha are largely made use of in mines, and are generally found to be much more durable and economical than leather buckets; while pumps made entirely of gutta percha are occasionally made use of in chemical factories. Belting of gutta percha answers extremely well in many cases; but it is sufficiently obvious that the use of this kind of belting is only to be recommended in cases where the temperature of the place is not likely to rise very high.

Funnels, bottles for hydrofluoric acid, jugs, boot soles, various surgical appliances, and fancy articles are also made of gutta percha, and there are on the table some really fine works of art executed in this material, and lent by the Gutta Percha Company. Articles of gutta percha may be varnished by an oil varnish, that is to say, by means of a resin, or resinous gum, dissolved in boiled linseed oil, the varnish being diluted with oil of turpentine as required.

Gutta percha does not appear to be so absolutely impervious to water, as is sometimes believed, as thin leaves or sheets of it left in water for a long time absorb sufficient to cause them to sink. The specific gravity of gutta, under ordinary circumstances, is about ·979, but the above mentioned circumstance tends to prove that the material, if perfectly free from porosity, would possess a higher specific gravity than water.

The vulcanisation of gutta percha is, in all respects, analogous to that of india rubber; and its primary effect is to lessen the influence of an elevated temperature on the material. As in the case of caoutchouc, vulcanisation may be effected by free sulphur, by sulphides in conjunction with free sulphur, or by certain agents which contain no free sulphur, as hypo-sulphite of lead and chloride of sulphur.

Parkes's cold curing process, in which chloride of sulphur is made use of as a vulcanising agent, can be applied in many ways to the vulcanisation of gutta percha. Here, for example, is a piece of thin sheet, which is being exposed under the bell jar to the fumes of proto-chloride of sulphur; it is already nearly cured. As regards the dipping process, certain precautions must be observed, as a mixture of carbon disulphide and chloride of sulphur rapidly dissolves gutta percha. Perhaps the following is the best way of proceeding:—The articles to be vulcanised are dipped for an instant in a mixture of one part of chloride of sulphur with twenty parts of carbon disulphide, no time being allowed for solution to take place. The dipped article having been allowed to remain for some hours exposed to the air, reacts with the small proportion of chloride of sulphur taken up from the bath, and its surface becomes partially vulcanised and insoluble. A second dip may now be given, but this time the liquid can be allowed to act during a longer period, the surface of the article being less soluble than was the case before. As the vulcanisation proceeds, the articles may be allowed to remain longer and longer in the bath; and the result is that the gutta is vulcanised all through. Vulcanised gutta percha is, with few exceptions, hard, and indifferent alike to the action of solvents, or of a temperature as high as 100 deg. Centigrade. Another way of curing gutta percha by the method in question will next be illustrated to you. Here is a solution containing four parts of gutta percha dissolved in twenty parts of carbon disulphide; and here, on the other hand, is a mixture of one part of proto-chloride of sulphur with eight parts of carbon disulphide. Having now mixed these two solutions, I will pour one half of the mixed liquid into a stoppered bottle, and the other half on a levelled glass plate. In about ten minutes the liquid in the bottle will have set to a jelly, owing to the fact of the gutta percha having become vulcanised and insoluble, while that poured on the levelled glass will form a film or skin of completely vulcanised gutta percha, which almost resembles ivory in appearance. Some specimens vulcanised in this manner are now on the table.

When gutta percha is cured or vulcanised by the admixture of sulphur and subsequent heating, the most serious source of failure met with is porosity of the material, this being probably due to two causes. In the first place, traces of moisture may be present; and, in the second, there appears to be some vapour evolved during the earlier stages of the curing.

Traces of water, or of mischief-working essential oil, may be often driven off, by heating the gutta to 150 deg. for some time before incorporating the sulphur; or the volatile products formed during the earlier stages of vulcanisation may be got rid of by heating the gutta to 135 deg. with 2 per cent. of sulphur for an hour, and then mixing the very partially cured material with 6 to 10 per cent. of sulphur, making up the required articles, and curing as in the case of rubber. Very hard vulcanised gutta may be made by incorporating a large proportion of sulphur, say 30 to 50 per cent., and curing, as for ebonite. Colouring matters may be incorporated, but the production of light tints is not so practicable as in the case of vulcanite from rubber.

Hancock's method of vulcanising with a mixture of sulphide of antimony and sulphur yields an excellent result with gutta percha; six parts of the sulphide, one of sulphur, and 48 of gutta being good proportions. The curing requires a temperature of 135 deg. to 140 deg. Centigrade.

You see before you some very interesting specimens of vulcanised gutta percha, for which I am indebted to Mr. Walter Hancock; you will notice how perfect and sharp the detail on this medal is; it being difficult to imagine the original device better defined than this is.

It now remains for me to thank you for your attention during this course; and my best thanks are due to the numerous gentlemen who have co-operated with me in my work, not only by lending me the products of their factories, but also in allowing me to visit their workshops whenever I had occasion to do so.

Your thanks and my own are also due to Mr. Barker, who has so ably helped me in the task of demonstrating many points of interest, which, without his aid, would have been impracticable.

Information conveyed through the medium of a short course of lectures is necessarily very partial and fragmentary. The things which have been omitted are naturally more numerous than those which have been said.

THE "JOURNAL OF GAS LIGHTING" ON THE CITY COMMISSIONERS AND ELECTRIC LIGHTING.

"It is stated on the part of the Streets Committee, that the gross cost of the experiment will be about four times the price now paid for gas lighting, inclusive of the establishment expenses. We hav heard something lately concerning the elasticity of City estimates, and it would possibly be instructive to see, after the year's trial is over, a fair balance struck, including every expense to which the City will have been put in consequence of this experiment. Still, a disproportion of four to one is enough to cause an indifferent observer to inquire why it is to be incurred—whether gas lighting has failed, and a great and sudden demand has arisen for lighting by electricity. For, be it remembered, there is no question of illuminating power considered, or if considered it does not find a place either in the report of the committee, or in the speech of the gentleman who moved its adoption in the full court. Not even by way of preamble is it stated that 'whereas it is expedient to provide better means of lighting the thoroughfares within the City, especially after business hours; and whereas it has been demonstrated that the present method of lighting by gas is a failure; and whereas it has been proved that, on the grounds of constancy, reliability, cheerfulness, and economy, the electric light is infinitely superior to gas,' &c. If something of this kind had been offered by way of explanation of the action of the Commissioners of Sewers, we should have known how to regard their proceedings; but as they give no reason at all, not even so much as was vouchsafed in the late controversy anent the Dragon of Temple Bar, we are constrained to believe that their motives are about equally rational in both cases, or that, from merciful consideration for the interests of gas shareholders, they decline to announce their convictions on the subject of the inefficiency of gas as a medium for lighting streets. It does not appear, however, that even all the members of the Commission are quite sure of the object of the experiment. Mr. Deputy Taylor is reported to have complimented the Streets Committee on the results of their labour in receiving the tenders, and in going about inspecting the various examples of electric lighting at present visible in the Metropolis; and probably feeling called upon to supply a meaning to the investigation, he concluded by expressing a hope that it would result in the public being supplied with an improved light at less cost than at present. Here at least we have a definite, though unofficial, object stated, and it is with quite a pang that we venture to observe that to begin by paying four times more than before is not the most obvious way of obtaining a cheaper light, to say nothing of the improvement in quality which is expected to follow. We fear the cheapness of the experiment must not be mentioned in view of the admitted figures, which, as we have seen, may hereafter be somewhat altered for the worse."

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SWAN'S ELECTRIC LAMP.

It has been remarked over and over again to us that had the invention of a similar lamp to that of Mr. Swan been the work of an American the whole public press of England would have been filled with pessimist articles on the subject. Any work—good, bad, or indifferent—from foreign quarters is certain of laudation by the penny-a-liner. We must guard ourselves against misinterpretation here, and say that we are not referring solely to Mr. Edison and his work. So far, however, as his statements concern the electric light we do include him as fixing one quarter from which a good deal of tall talk has emanated. That Mr. Edison has and is doing good work we do not deny, and shall be the first to give him credit for any success he may achieve. What we wish to condemn is the manner in which the contemporary press meddles with what it does not understand. *The Times*, for example, has more than once given publicity to statements that have turned out to be anything but what they purported to be. But although *The Times* had an account of Mr. Swan's lecture at Newcastle, with independent assurance from disinterested people that a certain amount of success had been achieved, "The Thunderer" did not deign to notice the Englishman's work at all. Had a message been flashed across the Atlantic that plain Tom Jones, or from Berlin that Herr Schmidt had discovered a cheap incandescent lamp, there is little doubt that a full description would have been given by the various papers. Mr. Swan, of Newcastle-on-Tyne—a town, be it observed, in the county of Northumberland, which, although some distance from London, is still a part of England—Mr. Swan, we say, makes a discovery, and with the exception of three or four of the first-class technical papers it passes unnoticed. Can anyone explain this? Writing on the same evening as Mr. Swan reads his paper before the Society of Telegraph Engineers we may imagine that the morning papers will to-morrow contain more or less full accounts of the meeting; but, still, that gives no explanation of their previous silence. And this is the "press" that sways the fluctuations of the share market!

The Society of Telegraph Engineers must be congratulated upon the *éclat* with which it closed the session for holidays, and with which the winter portion of the session commences. Our readers will recollect the evening when Dr. Siemens described the results of his experiments with the electric light in horticultural matters, and they will no less vividly recollect the meeting of November 20, when Mr. Swan described his researches upon incandescent lamps. Both gentlemen entered a wide field of exploration, and who will be bold enough to say when the influence of these revelations will stop.

Mr. Swan in an exceedingly able paper roused the excitement of his audience but failed to altogether satisfy their curiosity. He commenced by discussing the comparative values of the light from the arc and by incandescence, and stated that the production of a large amount of light by means of the arc was an economical operation, but that it was not economical to produce small lights by means of the arc. He referred to the information that might have been obtained by real competitive trials at Glasgow. His experience had led him to doubt the arguments brought against lights by incandescence, and he therefore concentrated his attention to the production of such lights. We have often pointed out that the first step of a would-be inventor is to understand what is wanted—to find out the defects in existing apparatus and then to set about the improvement. This is exactly what Mr. Swan has done. He told the members of the Society of Telegraph Engineers that the old form of incandescent lamps contained three properties conducing to failure. 1. The carbons used were too thick, requiring a large current which was not economically utilised; 2. The carbons were not durable; and, 3. The glass obscured the light. Mr. Swan has endeavoured to perfect his lamp in these three directions. How far he has succeeded time alone will prove; but the unanimous verdict of a large and appreciative audience was that if success was not absolutely assured, the lamps were far better than any in the history of electric lighting. It was admitted that the electric light might now be applied to the lighting of ordinary rooms, and although there was a little mild criticism on the score of expense, the opposition seemed to criticise more for the sake of saying something than for the purpose of convincing those addressed.

We are pretty certain that the question of expense will not interfere with the adoption of the electric light. Besides, the difference in the cost point of view is being so rapidly minimised that even if expense is to be considered gas will be beaten by its rival. Let us briefly consider the question, however, from another point of view. We suppose that the householder possesses, as many do, a valuable library, valuable paintings, silver in various forms and shapes, his rooms are tastefully decorated at a considerable expenditure of money. How does the system of lighting by gas affect him? His books are spoilt, as are his paintings, his silver is tarnished and needs constant cleaning, his decorations are soon rendered dim, and the bright and beautiful is dull and

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lustreless. The fact is that gas light has but one redeeming feature. It is easily lighted—turn a tap and strike a match, and your light is obtained. But the electric light, as put forward by Mr. Swan, is just as simple. Turn a screw and you have your light. Gas is dirty, disagreeable, and dangerous. The electric light, on the contrary, is clean, pleasant, and far less dangerous than its competitor. Our books are not damaged, our pictures not spoilt, our ceilings remain clean, ventilation is better, there is less generation of impure gas, and we maintain that if the electric light bill is twopence a week more than the gas bill, the former light is, in reality, a good deal cheaper in the end. Hitherto, we have never put forth the claims of the electric light as they can be put forth, for the simple reason that the time was not yet. The introduction of Mr. Swan's lamp, however, removes the principal causes, and the whole subject can be, and must be, considered *de novo*. Our contention, then, is that for the illumination of all houses of a fair size, and occupied by well-to-do people, the electric light is cheaper than gas. We take everything into consideration, even to the question of first cost, which, in the electric system, will be found much less than with gas. But we quite agree with Mr. Swan that gas shareholders need not fear—their production will find other uses, and their profits will not diminish.

CORRESPONDENCE.

THE ELECTRIC LIGHT IN THE CITY.

TO THE EDITOR OF THE ELECTRICAN.

SIR: The publication of the results of tenders for electric lighting in the City, together with the delay in publishing the official record of the Glasgow trials, has compelled me to request you to give space for the following remarks.

Anyone reading the published figures would come to the conclusion that for the year's lighting of the No. 1 district of the City the Brush system will cost the ratepayers £22 5s. per 1,000 candle power supplied, whereas the Crompton system would have cost them £29 10s. for the same candle power. This is entirely untrue and misleading, and is based upon an erroneous use of the term "candle power." As is well known, this term is highly elastic, and upon its use or misuse a great many unfair statements have been based.

However, I challenge anyone connected with the Brush system of lighting to show that at any time, or under any conditions whatever, the Brush light, valued at 2,000 candles, ever approached one-fourth of the power of the single light, given by the A Gramme machine, which is usually valued at 4,000 candles. I will go further, and state publicly that had not the Brush system been withdrawn from the competitive trials at Glasgow, the fact would then have been made patent to the world that, under equal conditions of measurement—if 1 h.-p. used in the Gramme system gives the light of 1,000 candles, 1 h.-p. used in the Brush system gives the light of 300 candles only. These figures may be increased or diminished, but the proportion between them remains as above.

The facts and figures are really far less favourable to the Brush system than this, but I have preferred to keep on the safe side.

If these figures had been applied to the estimation of candle power in the City tender, the Crompton system would have been found to be far cheaper than the Brush for equal light supplied.

—Yours, &c., W. CROMPTON.

Mansion House-buildings, Queen Victoria-street,
November 24, 1880.

M. MASCART'S ELECTROMETER.

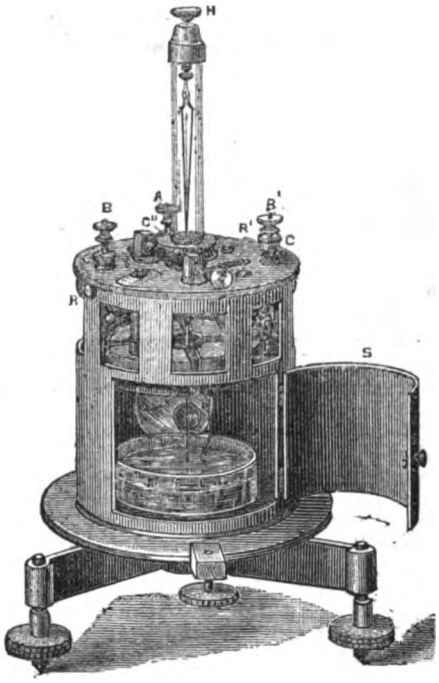
This instrument is employed for comparing the electric potentials of various sources of electricity. Founded on a principle established by Sir W. Thomson, it embraces the chief features of the electrometer conceived by the English physicist. M. Mascart, while simplifying the arrangement of the various parts of the instrument, has succeeded in retaining its sensibility and exactitude.

A metallic cylinder, the door of which is represented in our illustration as being open, protects the delicate appliances of the electrometer from the air and all external electrical influences.

Inside, and attached to the upper part, is a double thread of cocoon silk, to which is suspended an aluminium needle, shaped like the figure 8. This needle oscillates within a kind of box, formed by four quadrants, or hollow sections, which can be seen through the open windows over the door S. The quadrants are bound two by two diagonally by means of silk-covered copper wire. The insulated conductors enable us to communicate to the two pairs of quadrants equal charges of electricity of contrary signs. In order to do this they are separately put in communication with the two poles of a constant current battery, the middle pair of whose elements is put to earth. One group will then be electro positive, and the other electro negative.

As regards the needle it is electrified, whether positively or negatively, by the introduction of the platinum wire P, which is plunged in a glass vessel filled with concentrated sulphuric acid. In the same liquid is immersed a second strip of platinum, O N, which goes to the needle, and which is also in electrical communication with the wire P.

In a state of repose, all the parts communicating with the earth, the needle should be evenly covered by the two pairs of quadrants. If these are equally charged with opposite electricity the



needle remains stationary; but if at the same time the needle itself is also electrified, either positively or negatively, the sections immediately act upon it, the one attracting, the other repelling it. By reason of these combined actions and according to the nature of the charge communicated to it, the needle is deflected to one side or the other.

In order to compare by means of this arrangement the electric tensions of various sources of electricity, a constant charge must be conveyed to the two pairs of quadrants, and the needle then be put in relation with each of the two sources. The deflections, if due care be observed, will be proportioned to the potentials under examination.

The reading of the deflections is done by the aid of a small mirror, M, supported by a strip of platinum attached to the movable needle, the image of a luminous point being cast upon a graduated scale. By adapting the number of cells for charging the quadrants to the electrical sources to be examined the amplitude of the deflections can be kept within narrow limits.

Two screws, R R', secure the exterior cover. The quadrants are fixed to this cover by insulated rods. In order to adjust, one of these can be displaced by slightly turning, one way or the other, the head of the screw V. The binding screws B B' communicate with the exterior; and A, connected with the platinum P, allows the needle to be electrified by means of the cup without interfering with the oscillations of the needle.—*Revue Industrielle.*

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LITERATURE.

Les Principales Applications de l'Electricité. Par E. HOSPITALIER, Ingénieur des Arts et Manufactures. [G. Masson, Paris, 120, Boulevard Saint-Germain.]

We heartily welcome this work of M. Hospitalier. It is only within the past two or three years that this gentleman has entered the domain of literature, but from his first entrance he has been indefatigable in gathering information. Not only does he gather his information from the best sources, but he is anxious thoroughly to understand the scope and the aim of what he hears or sees. The production of the work before us must be looked upon as the first fruits of a career of more than ordinary promise. The development of electrical science during the last quarter of a century is somewhat startling even to those who are accustomed to watch the progress of science, and the promise given of further development in the immediate future is calculated still more to increase our wonder. M. Hospitalier deals with that branch of electrical science which brings itself home to the minds of everyone, viz., its applications to our everyday needs. He refers briefly to electric batteries, not forgetting to discuss the units of measurement, over neither of which, nor over any definition will we at present break a lance. Thermo-electric batteries are more fully described than we remember to have seen them elsewhere, and we think justly so, for many electricians of repute hold that we may look for great work in this direction. He endeavours to classify "Electro-dynamic" machines, so as to somewhat systematise the study of these machines. All these machines are founded upon the discovery of Faraday, and in accordance with the laws known as those of Lenz and Mateucci. The principal machines giving continuous or alternate currents are described and amply illustrated, and the concluding paragraph of Chapter III. points out that the telephone is a magneto-electric machine, the most sensitive and the most delicate of all such machines. The first part of the volume ends with a chapter, a large portion of which is devoted to the consideration of secondary batteries, and here again the author touches what is practically a new and unexplored field, one, however, full of promise. The second part, containing four chapters, deals with the "Electric Light," the electrical problem of to-day, about which the author has given a large amount of information in a compendious form. We are not quite sure as to the wisdom of criticising the Edison incandescent lamp too sharply. It must always be remembered that a light by the arc method must necessarily be of great intensity, far greater than is used in an ordinary room, and that at present the only method of obtaining a reduced light is to use an incandescent or a modified system. M. Hospitalier's book was, of course, written before Mr. Swan's lecture was given, or Mr. Swan's statement would also have been considered. *En passant*, we are anxious to know *when*, *where*, and *how* Mr. Swan first made public his system, in order to determine what amount of credit is to be given to Edison, Maxim, &c., for their *carbon thread* lamps. At present the credit given is a negative quantity, on the presumption that the hint was obtained from Newcastle, but such hint has not been acknowledged. To resume, M. Hospitalier discusses at considerable length the applications of the electric light, and concludes that its limits include the whole area where light is required. The third and fourth parts are respectively devoted to the consideration of telephones and microphones and "Modern Telegraphy" and "The Transmission of Power." Here, as throughout, the subject is treated concisely and clearly, the latest developments being considered, and a continued attempt made to systematise the whole subject. M. Hospitalier has in this work dealt principally with such applications as have hitherto not found descriptions in text-books, showing how rapidly the pure and applied science progresses. One of the greatest claims the author has to our consideration is the simple manner in which he treats his subject. Moreover, when we consider that the explanatory matter is still further elucidated by means of numerous and excellent illustrations we are able to speak of the book as a valuable acquisition to the literature of electrical science.

THE ELECTRIC LIGHT AT THE KIOSK, BOW-STREET.

There are six lights in one circuit of 400 candle-power each; one on the outside, suspended by a bracket from the top of the first floor, enclosed in a globe of ground glass; two in the ground floor and two in the first floor in opal globes. In the basement there are two small brackets fixed, one in the store room (from which the bakehouse is also lit up) and the other in the soda water machine room, and one lamp is so arranged that it can be easily removed for use at either as required. The lamps are self-regulating, and act independently of each other, *i.e.*, should one be allowed to go out, it does not in any way affect the others. The carbons burn without change for five hours. By means of a commutator under the control of the manager in the ground floor bar any one or more of the lights can be at once extinguished by simply inserting a plug, the withdrawal of which again instantly relights them. A resistance, an arrangement of carbons equal to that of the lights put out, is also inserted at the same time, thus avoiding any variation in the driving power of the engine and ensuring steadiness of its light.

The system of lighting is that of the Messrs. Siemens Brothers, here introduced by Messrs. Calder and Barrett, electricians, 154, Westminster Bridge-road, S.E., who have carried out the entire arrangements connected therewith.

The alternate current machine or generator with its excitor is fitted up on the ground floor in the centre of the room, under a plate-glass and oak case, which serves as a table, and, of course, to be seen being driven. This machine is capable of giving eight lights altogether, of 300 candles, in one circuit, or it may be divided into two circuits of four lights each. On releasing a plug in the commutator, electrical shocks can be received by standing on a foot plate on the floor, and placing the hands on the brass rim of the frame.

The steam engine and driving gear have been supplied by Messrs. Wallis and Steevens, of North Hants Ironworks, Basingstoke. The engine is of the semi-fixed type, and is of four horse nominal power, the diameter of the piston being 6¾in., and the stroke 10in. This build of engine, only larger, by the same makers, has been driving electric-lighting apparatus very successfully for the last year at various places, and has been found most economical. It is fitted with the maker's patent feed-water-heater, and has a jacketed cylinder and every appliance for reducing the cost of power. The engine runs very steady, free from vibration, and will, if required, work to nearly three times its nominal power. It here also drives a coffee mill and soda-water machine, and is of sufficient power to drive an electrical machine capable of supplying 16 to 20 lights in two circuits of the above candle-power, and also supplies steam for heating water for the establishment.

HISTORICAL MEMORANDA ON SUBMARINE TELEGRAPHY.

BY F. C. WEBB, M.I.C.E., M.S.T.E.

(CONTINUED FROM PAGE 309, VOL. V.)

It should be mentioned that on the laying of the Ostend cable, and also on the laying of the then first Hague cables (laid May 30, 31; June 16, 17; and Sept. 8 and 9), Mr. Spencer and Mr. Thomson acted as assistants to Mr. Newall, and took an active part in the work. Messrs. Reid and Sons tested the Ostend cable during manufacture, and the author tested the Hague cables. One fact connected with the testing of the Ostend cable worth recording is the testing of the coils of gutta percha covered wire under pressure by taking them out to sea in a tug from Sunderland, and lowering them down over the side in some ten or fifteen fathoms of water, the ends being kept up, and tests applied from some 120 elements. The tests of the Ostend cable were taken on vertical galvanometers. The Hague cables were tested with a horizontal galvanometer and 120 elements, and the resistance of the conductor was also obtained by taking the deflection on the galvanometer with one element as every ten miles were added to the length of the cables, and for four years the tabulated results of these tests formed one of the principal means of localising faults when they occurred. In testing the Ostend and Hague cables during manufacture and laying the old sand battery was used.

The first break down in the Hague cables occurred to No. 1 cable (the second laid) on Aug. 17, 1853. The author tested from Orfordness on the following day, and made the fault close to the Dutch coast. The author started on the 20th from Blackwall in the "Copeland" paddle tug, with Mr. Oliver, mate of the "Monarch," Windle, from the Gutta Percha Company, as gutta percha jointer, and Bruce, from Glass and Elliot's, as splicer. Windle became permanent jointer in the "Monarch," and afterwards foreman, and will be remembered by many for years as Mr. Windle, one of the principal foremen of the Telegraph Construction Company; Mr. Bruce is at present foreman at the Construction Company's works at Morden Wharf. After touching at Orfordness to give instructions we proceeded to the Dutch coast, and found the cable cut in two seawards of the

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shore end, and not far from it, and spliced it upon the 22nd. This was the first case of a cable breaking down and then being repaired.

In this same year (1853) a cable made by Messrs Newall, at Sunderland, was laid across the belt for the Danish Government. It had three conductors of No. 16 copper covered to 3½ g.p., and closed with 9 No. 1 gal. iron wire, and was 16 miles in length. It was laid by a Mr. Robinson from a schooner in tow of a tug, and is the first example of laying a cable from a ship in tow. In November of the same year the author laid a cable of exactly the same pattern across the Solent from a fishing cutter, with her mast removed, in tow of a tug. In December of this year the author laid from the "Monarch" the cables across the Firth of Forth and River Tay. The pattern of these cables was four Hague cables laid up together in a similar manner to the six-strand shore-ends of the Hague cables.

1854. In May of this year the "Monarch" was chartered by Messrs. Newall and Co. from the Electric and International Telegraph Company, and a picking-up apparatus designed by Mr. Newall placed on board. It consisted of two drums about seven feet diameter, with grooves in their drum surface about the depth of half the diameter of the Portpatrick cable. These drums were driven by a pinion working between them into spur wheels on the drum shafts. Bow baulks were fitted with a bow sheave about six feet diameter, with wrought iron spokes. The baulks projected beyond the sheave, and a bolt kept the cable in between, but no cheek guides either of cast or wrought iron were used. With this machinery the 16 miles of Portpatrick and Donaghadee cable were recovered by Mr. Newall. The exact date of this expedition the author has not, but it forms the first example of picking up a cable, and the machine having two drums with grooves has never been since employed for picking up from the bows. The paying-out gear of the 1858 Atlantic was somewhat similar as regards two grooved drums. On October 6 of this year the single drum picking-up gear, with knife to fleet the turns, designed by the author, and made by Messrs. Easton and Amos, was fitted on board the "Monarch." A drawing of this machine is given in the author's paper, read before the Institution of Civil Engineers on 23rd February, 1858. It is the first example of a single drum picking-up gear with knife. It had also a ratchet, and could be worked by manual power, long handles extending on each side of the driving shaft to bearings on the gunwale of the vessel, and thus about thirty men could be applied to it. Steam power was applied the same year, as the work got heavier.

On September 4 of this year a cable exactly similar in type to the Hague cables was laid between Holyhead and Howth, from the "Monarch," the break being fitted by the author. The expedition was under Mr. E. Clark, assisted by the author.

SWAN'S LAMP AT THE SOCIETY OF TELEGRAPH ENGINEERS.

A very large gathering took place at this Society's rooms, Great George-street, Westminster, on Wednesday evening last, in order to listen to Mr. Swan's exposition of his new electric lamp, and to witness its performances before a professional audience. Mr. W. H. Preece, the President, occupied the chair, and amongst those present we noticed Messrs. Latimer Clarke, Cromwell F. Varley, Sir C. Bright, Professor Tyndall, Dr. Siemens, Professor Hughes, Professor Forster, Professors Ayrton and Perry, Mr. Crompton, Mr. Willoughby Smith, Mr. Spagnoletti, Dr. Hopkinson, and many others well known in electrical and scientific circles. Various specimens of the lamps, exposed as well as enclosed, were suspended overhead, and one occupied the lecturer's table, having the appearance of an ordinary table lamp. These were all lighted later on in the evening, and remained burning to the end. We shall describe them fully as we proceed.

Before introducing Mr. Swan, the President announced that the trustees of the Ronalds Gift had made the inspection of the collected works, and had expressed their opinion that everthing had been done in accordance with the conditions of the bequest. Arrangements would shortly be made, it was hoped, for opening the library not only to the members of the Society, but to the general public under certain conditions, and a proposition would be submitted to the members very shortly for carrying out this intention.

Mr. Swan, who was very warmly received, began by remarking upon the, as he thought, undue attention that had been given to lighting by means of the electric arc, lighting by incandescence—that is to say, the white heat of a continuous conductor, having been very little considered, at all events, in this country. Theoretically there was no question as to the superiority of the last-named mode of lighting, especially where a number of lights were required, over the more familiar method, and he was long ago persuaded that incandescent lighting was the one and only form of popular light possible, if popularity was ever to be won for any system of illumination by means of electricity.

As to the arc, its use is obviously limited. It can only be employed in large areas, for to attempt to use it where the space is small would be to waste the excess of light extravagantly, and to attempt to split it up into smaller lights, still of the arc pattern, the objections on the score of cost became very serious. These objections applied even to the Werdermann and Regnier lamps, although they were not, strictly speaking, arc lamps; for, on the other hand, they did not possess the distinctive merits of the incandescent systems. Mr. Swan expressed his regret that the question of expense was still kept very much in the dark, and that at the recent competition at Glasgow, from which so much was expected, only one lamp (Mr. Crompton's) faced the ordeal of an exhaustive test. In the absence of figures, therefore, Mr. Swan observed, regarding the cost of producing arc lights, we have only impressions, and the impression conveyed to the minds of most observers was that the biggest light was the cheapest—possibly, indeed, that a very big light was a very cheap light. But here all trustworthy evidence in its favour ended. On the other hand, the drawbacks to its use for ordinary purposes are manifest. Over and above those already mentioned, there are the expenditure of candles and the act of renewing them, skilled attendants being required to periodically attend to them. Then again there was the intense and superfluous amount of light concentrated in one spot, not merely diminishing very rapidly in strength as it extended, but by its very lustre disabling, so to speak, the spectator from getting the full advantage of what light remains for the more remote portion of the area illuminated. The amount of light given off by a powerful arc was, if measured by so many candle-power, very inconclusive testimony to its capacity for adequately lighting a given area; for while the same aggregate illumination would light very sufficiently a given space if suitably distributed over that space, concentrated at one spot it would light it very imperfectly. It follows that as the arc will not adapt itself to this distribution without great additional cost, its use for the ordinary purposes to which gas is now applied is quite out of the question.

Realising these facts, Mr. Swan abandoned the idea of arc lighting altogether for general uses, and about three years ago took up again his old experiments in the field of incandescent lighting. These experiments refer to a period long before the era of dynamo-electric machines and Sprengel's air pumps, the perfecting of which in recent years encouraged Mr. Swan to overcome the difficulties which had led to failure twenty years ago. Whilst Mr. Edison was endeavouring to produce a useful incandescent lamp by means of platinum Mr. Swan was endeavouring to obtain the same end by means of carbon. It had appeared to me, continued the lecturer, for many years that if ever electric light was to become generally useful, it would, most probably, be by means of the incandescence of carbon. I had, long before the time to which I am referring, attempted to render this idea practicable. As a matter of history, I will briefly describe an experiment which I tried about twenty years ago. I had a number of pieces of paper and card of various forms and sizes buried in charcoal in a crucible. This crucible I sent to be heated white-hot in one of the pottery kilns belonging to Mr. Wallace, of Forth Banks. From the pieces of carbonised card which I thus obtained I selected a long spiral. The ends of this I clipped between small blocks of carbon, carried by uprights and connected with conducting wires. A small glass shade was cemented over this mounted carbon spiral, and the air was exhausted by means of a very good air-pump, lent to me for the purpose of this experiment by the Rev. Robert Green, of Longhorsley. A good vacuum (according to the ideas that then prevailed) having been produced, I applied the wires of my battery (consisting of 10 cells of Callan's modification of Grove's battery) with great expectation of a brilliant result; instead of this, there was the most absolute negative presented to me; not a vestige of heat or light appeared in my long ringlet of carbonised paper. It was evident, and I immediately recognised the fact, that the electric current of the strength I was using would not go in sufficient quantity through so long a piece of carbon as I had taken. I therefore repeated the experiment with shorter carbon and a greater number of cells, and I obtained, under these altered circumstances, an extremely interesting result. My carbon was in the form of an arch (this diagram will help my explanation), about one inch in height and width, and the strip forming the arch a quarter of an inch broad. The ends of the arch were held in small clamps, with square blocks of carbon. The air pump having been worked, I had the pleasure of seeing that when contact with the battery of forty or fifty cells was completed, my carbonised paper arch became red hot, and it was evident that nothing more was wanted than a still stronger current, to make it give out a brilliant light; but I had used up all the battery power at my disposal, and having reached this limit, I contented myself with watching the behaviour of the arch, the engrossing question being—how long will it endure? I noticed that the inner part of the arch was hotter than the outer part, and that, perhaps in consequence of this, the arch became bent on one side. This bending gradually increased, until at last the arch had so far curled down that the top was on a level with the clamps, and on coming in contact with the sole of the lamp it broke in two, and the experiment collapsed. That, I confidently belive, was the very first instance in which carbonised paper was ever used in the construction of an incandescent-carbon lamp.

The lecturer then briefly sketched the various attempts that have been made in recent years to produce a good light in vacuo, mentioning in particular the Sawyer-Mann and the André lamps. But in all these attempts two great difficulties had stood in the way and baffled every attempt to overcome them. One was *the rapid wearing away and consequent breaking of the incandescent carbon;* and the other *the obscuration of the lamp by a kind of black smoke.* So uniformly did these phenomena present themselves that the idea was propounded and generally accepted that the blackening of the lamp globes was due to volatilisation of the carbon under the action of the enormous heat to which it was subjected.

Fortunately Mr. Swan did not accept this dictum, and he determined to try the experiment of heating the carbon to a state of extreme incandescence, so driving out the occluded gas, and then placing it in a vacuum such as Mr. Crookes has taught us how to procure. Mr. Swan, it may here be mentioned, had given up all attempts with platinum and iridium, for reasons which, no doubt, have led Mr. Edison to turn to carbonised cardboard in preference. Assisted by Mr. Stern, the lecturer had succeeded at length in constructing a suitable vessel, obtaining a perfect vacuum, and inserting a new material, which, to all appearance, was both durable and thoroughly satisfactory in every way. The secret—for there was a secret—was in the material, and until the patent was published he felt reluctantly compelled to be reticent as to what kind of carbon—if carbon it was—he had contrived. It was hard and elastic, and in appearance like a black bristle—very little, if any, thicker—and bent into an arch. This was enclosed within a glass vessel resembling a Prince Rupert's drop, and not much larger. For the table lamp before referred

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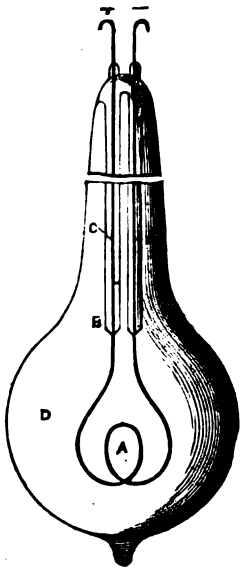
THE CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
French Government	ss Ampère	—	—	—	—
Telegraph Construction	ss Calabria	3,325	300	—	Victoria Docks.
Henley's	ss Caroline	526	70	—	North Woolwich.
French Government	ss Charente	—	—	M. Dufour	—
Eastern	ss Chiltern	1,304	200	W. Goodsall	London.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Algiers.
Telegraph Construction	ss Edinburgh	2,315	275	J. Seymour	Victoria Docks.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	W. F. Wardroper	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	A. Killett	Victoria Docks.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Canadian Government	ss Newfield	785	90	R. A. Guildford	Canada.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Great Northern Company of Denmark	ss J. B. Oersted	—	—	—	—
Paris and New York	ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	—
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	—
Telegraph Construction	twin screw Scotia	4,667	550	W. R. Cato	Atlantic
Telegraph Construction	ss Seine	3,579	500	H. Manning	Victoria Docks.
Eastern Extension	tw screw S. Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	—	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.

to one of these was sufficient, and the ease with which it might be taken in and out of the standard was shown before the audience—the light being extinguished by its removal, and instantly reappearing on its insertion. For the globes overhead, of which there were ten, not to mention some groups of separate smaller lights, three of these little glass pendants were joined together at the necks, the whole being enclosed within an opal globe of the usual pattern. The lighting of these lamps, preceded by the extinction of the gas, was hailed with enthusiastic applause, for, as was remarked by speakers who followed, this was the sort of light that was wanted. The colour was altogether unlike what had been seen and objected to hitherto, and more nearly resembled gas than any electric light yet exhibited. Besides being perfectly silent, it was steady, and the slight fluctuations which did occur were hardly noticeable.



A is the carbon strip the shape of which may be modified. D the containing globe. B the carbon holders.

Mr. Swan then went on to state that with this lamp one Weber of current would give 60 candle power. The resistance of each lamp was 150 ohms. A Gramme (B) machine was used, being placed in Parliament-street, not far distant, and an engine, probably using about 4 horse-power, for the 31 lights exhibited. To several persons present this statement seemed doubtful, and it was called in question by speakers who followed. But as the lecture was for illustration, and not for testing, no particular care had been taken to reduce the power on the one hand or to increase the number of lamps on the other. On this occasion the lamps were arranged in multiple arc. For carrying the lights to a great distance a greater power would have to be used in order that they might be fixed in series. In conclusion, Mr. Swan frankly gave it as his opinion, that although this undoubtedly was a solution of the lamp difficulty and of the question of subdividing the electric light indefinitely, there were practical difficulties to be overcome before it could compete with gas, and as to gas being superseded, he did not apprehend that the gas companies' dividends would be reduced by one halfpenny for all that he or anybody else could do.

Mr. Crompton, Dr. Hopkinson, and Mr. A. Siemens followed, all congratulating Mr. Swan on the surprising display of the evening. M. Berly also spoke, giving it as his opinion that divided lights, not great lights, would be in greatest demand, as proved by the experience of the gas companies. Professor Tyndall hoped that the lamp might be found useful in mines, a point upon which the President expressed grave doubts. He (Professor Tyndall) also inquired as to the durability of the carbons; to which it was replied that some lamps of the kind had been burning with only three weeks' rest since August 8th. Mr. Varley suggested the use of some attenuated metallic vapour to fill the globes, and Professor Ayrton challenged the economy of the light on the ground that if Mr. Swan's calculations were correct for his lamps, then it was certain that the arc lamps were enormously cheaper than gas, which was, in reality, not the fact. From this and what was afterwards admitted by Mr. Swan, it would appear that in the aggregate his light is not cheaper, but dearer, than the arc; but that, inasmuch as the arc cannot be distributed where it is wanted, it is, for ordinary practical purposes, more costly than incandescent lighting, the expense of which, as well as its illumination, can be divided among a number of consumers.

In according a hearty vote of thanks, the President announced that on the 8th December he would bring before the Society some recent advances in the production of sound by radiant light, and that probably Professor Bell would be present with his photophone.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Nov. 24.		Business Done Week Ending Nov. 24. Highest.	Lowest.
Anglo-American Ordinary	61¼,	¾	61¾	61
Do. "B"	91,	½	91½	91
Do. "A"	32¼,	¾	32¾	32¼
Brazilian	9 13-16,	15-16	9 15-16	9 11-16
Cuba	8¾,	9¼	9 1-16	9
Do. Ten per Cent. Pref.	16,	½	16½	16¼
Direct Spanish	2¾,	3¼	—	—
Do. Ten per Cent. Preference	12½,	13	12¾	12¾
Direct United States	11¾,	12	12	11¾
Eastern	9 11-16,	13-16	9¾	9 11-16
Do. Six per Cent. Debenture	103,	106	—	—
Do. Five per Ct. do. 1899	103,	105	106	105½
Do. Six p Ct. Pref	12½,	¾	12¾	12½
Eastern Extension	10,	¼	10¼	10
Do. Six per Ct. Deb	108,	111	—	—
German Union	10,	¼	10¼	10
Globe Telegraph & Trust	6¾,	¾	6¾	6 9-16
Do. Six p Ct. Preference	12 1-16,	3-16	12¼	12
Great Northern	10¼,	¾	10¾	10¼
Indo-European	24½,	5½	25	25
Mediterranean Extension	2¾,	3¼	3	3
Do. Eight p Cent. Pref	10¾,	11¼	—	—
Reuter's	10¾,	11¼	11¾	10¼
Submarine	255,	265	260	258
West India and Panama	1 5-16,	7-16	1¼	1 5-16
Do. Six per Cent. 1st Preference	6¼,	¾	6 13-16	6¾
Western and Brazilian	9 1-16,	3-16	9¼	8¼
West. Union 7 p. Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	104,	7	—	—

TRAFFIC RECEIPTS FOR OCTOBER, 1880.

Companies.	Oct., 1880.	Oct., 1879.	Increase.	Decrease.
Cuba Submarine Company	2,100 estd.	3,512	—	1,412
Direct Spanish Telegraph Company	1,821	1,370	451	—
Eastern Telegraph Company	47,570	50,251	—	2,681
Eastern Extension Telegraph Company	29,061	31,419	—	2,358
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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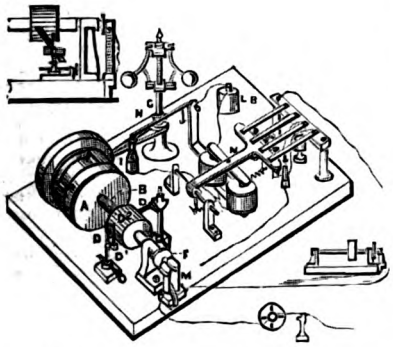
ABSTRACTS OF SPECIFICATIONS.

—o—

1385. IMPROVEMENTS IN DYNAMO OR MAGNE-TO-ELECTRIC MACHINES AND ELECTRIC MOTORS, *G. T. A. Edison.—Dated 5th April*, 1880. 6*d*.

Mr. Edison would like to stop the heating of the armature, and makes it of a number of very thin discs or rings. He has used discs from ·03125in. to ·015625in. thick, separated by sheets of tissue paper. The induced currents and produced heating effects thereby are reduced to a minimum, and the effective capacity of the machine largely increased. The commutator brushes are arranged to bear obliquely—angle of 30 deg.—on the face of the commutator instead of at right angles. To guard against wear, the shaft of the commutator has a longitudinal movement in the bearings. In order to obtain a constant motive power, a centrifugal governor is used to lift a circuit lever controlling the circuit to the motor. When necessary, the main circuit is broken in several places instead of in one, to divide the spark and lessen its total injurious effects, by the use of several contact springs. A brake is used to control the speed of the actuated machine, instead of interfering with the motor, and the motor is not geared direct to the machine to be driven, but other gearing is used between the two. The figures are clear, and need little

1385

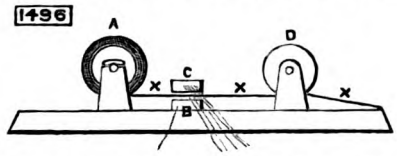


explanation. A is the rotating armature, composed of thin discs, secured to the shaft B, and insulated from each other by the tissue. DD are the brushes in stands D^1 acting on commutator D^2 at an angle preferably about 30deg. On the end of the shaft B is the disc F, which is as required attracted by the magnet M, or forced back by a spring, giving the longitudinal motion to the shaft. G is the governor, but is not necessarily in the position shown. The governor is connected through H^1 resting on stop I, with a small battery LB. This circuit includes an electro-magnet with armature N, widening out as shown into a plate under the free ends of four—less or more—circuit springs, with the other ends fastened to an insulated support. These springs, when not lifted by N, rest upon posts connected by wires. This arrangement is devised to keep the motor at a a steady speed, and break the circuit as required at several points. The inventor claims (1) the armature of thin discs, &c., (2) the combination of commutator, brushes, &c., (3) the reciprocating movement, (4) governor, (5) multiple circuit breaker, (6) break to actuate machine, &c.

1496. PRINTING MUSIC BY ELECTRICITY, *H. Y. Dickinson.—Dated 12th April*, 1880. 4*d*.

Two or more rollers are used, one of which, D, is operated by suitable means so as to revolve at a regular speed. Paper, X, similar to that used with Casselli's telegraph, passes round this roller, and is drawn over the table B and the box C from the roll A. Within the box C is a set of rulers, which rule on the paper five treble

1496

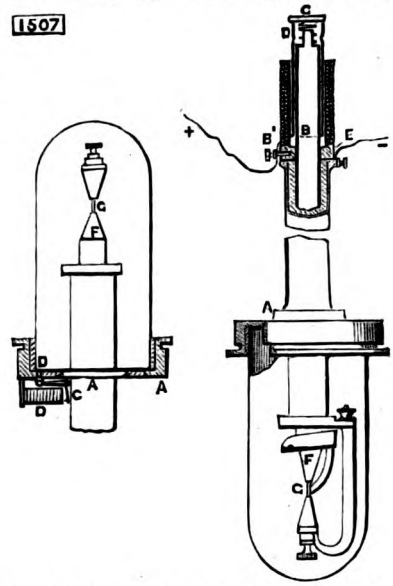


staff lines and five brass staff lines. The box also contains a number of movable pins which serve to print the notes, for which purpose they are connected by wires to the keys of the instrument played upon, and when a key is depressed an electric circuit is completed, and the corresponding pin acted upon by electro-magnets, and being drawn down marks a fine line on the paper, of a length corresponding to the duration of the note. The return wire of the circuit is connected to the table B.

1507. IMPROVEMENTS IN ELECTRIC LAMPS, *G. G. André.—Dated 13th April*, 1880. 6*d*.

This improvement to the ordinary André lamp is intended to overcome a defect in the latter. When carbon is burned in a closed vessel, during the passage of the current the vessel is found to contain CO and N, owing to the difficulty of making an air joint when the current ceases and cooling takes place ; air enters, and the resultant mixture is explosive, so that on relighting the carbons an explosion frequently occurs, which breaks the vessel and damages the apparatus. M. André feeds the lamp with a regulated quantity

1507

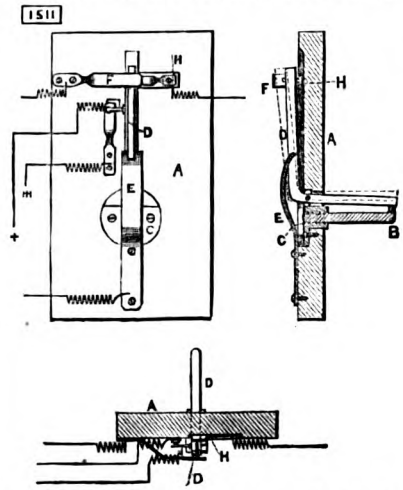


of air. In the vessel are two holes, through one of which air enters, while during cooling the other gases pass away by the other. Fig. 1 shows hole A in the cover of the closed vessel, while the carbon holder B is fitted into a cap C, in which are one or more holes D. Fig. 2 shows an inverted lamp with holes, as proposed by the inventor, who claims (1) the supply of a regulated quantity of air ; (2) the closing of one of the holes automatically by means of a solenoid or an electro-magnet.

1511. IMPROVEMENTS IN TELEPHONE SWITCHES, *J. H. Johnson.—Dated 13th April*, 1880.—(*A communication*) 6*d*.

This invention consists of certain apparatus to obviate danger of failure to make a signal in telephonic operations. A is a switch beam, B a metal post secured to a back plate C, on which is pivotted a vibrating crank lever, D. On the opposite sides at the upper end of D are contact points ; E is a split spring fastened and pressing as

1511



shown ; F is another spring connected with signal bell, similarly H which connects telephone and transmitter. On moving D it makes contact with F and breaks contact with H, and opens a local battery circuit so that current goes through E, D, and F to bell. When D makes the other contact it makes connection between transmitter and telephone. The claims are, first, the combination of B, D, and E ; secondly, the combination of connections with B, D, and E.

1552. ELECTRIC LAMPS, *A. M. Clark.—Dated 15th April*, 1880.—(*A communication.*) 6*d*.

The inventor of this lamp, M. Girard Lescuyer, of Paris, states that his aim has been to devise a simple lamp of great lighting power, with a small expenditure of motive power. He inclines his electrodes towards each other in the shape of the letter V. The figures given will show the whole mechanism and its connections with the plate C. The carbon guide A A is fixed, while A^1 A^1 is hinged to C ; the set screw F and the spring G allow of the regulation of the arc. The magnet I is in a derived circuit as shown. M M are gun metal rollers making contact and guiding the carbons—of which there are two in each holder—the lower ends of the carbons being shaped as in

1552

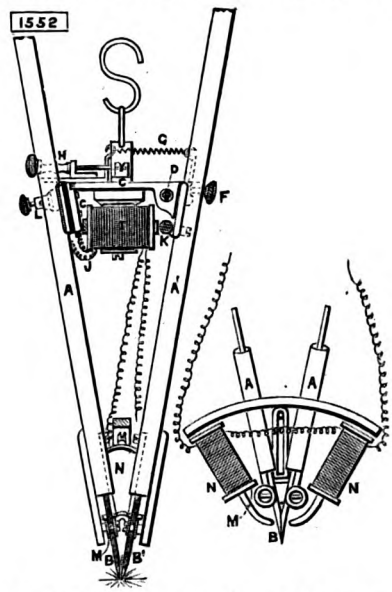


Fig. 2. The current passes through the magnets N N before entering the carbons. The action is as follows—regulate the distance between the carbons, connect L L with the source of current, the magnet I is excited and attracts its armature, causing contact between the carbons ; the arc now forms parts of the circuit instead of I, which is used solely to cause contact. The inventor claims (1) the double electrodes with bevelled edges ; (2) the double carbon holders and the mechanism of regulation ; (3) the magnet I ; (4) the magnets N N ; (5) the rollers M, and (6) the general arrangement.

1556. PROCESS FOR APPLYING ELECTRO-PLATING AND GILDING TO WOOD SURFACES, *Henri Alexandre Victor Wirth*. 2*d*.

The object of the invention is to use wood carvings as a base for electro-plating. The inventor first prepares the wood carving intended to be plated by destroying by means of known acids the superficial molecules of the wood ; and then places it in an oven of a temperature of 200 degrees, more or less, and for a sufficient length of time to completely dry it. Where any portions of the wood carving originally glued together have become separated by the heat they are securely fastened by nails or screws, of course filing off the heads so as to do away with any inequalities of surface. This precaution is necessary to prevent any such portions becoming disconnected during the subsequent processes. Such portions of the woodwork as may be flat and smooth should be punctured at intervals to enable the metal to penetrate and adhere, and to further facilitate adhesion it is advisable to plug such parts of the wood at intervals with copper plugs. The surface of the wood is then covered with a coating of plumbago, rubbed with a brush, so as to spread it uniformly and stop up all the pores of the wood. The wood carving thus prepared is placed in a solution of copper (scyanure of potassium) and subjected to the action of an electric battery, so as to give it by the ordinary process of electric plating a coating of copper, more or less thick in proportion to the length of time it remains in the bath. Coppered or bronzed carvings are thus produced. These coppered carvings can then be silvered or gilt by the process of electro-plating in the usual way.

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SLIP

CABLE REPAIRED.—Telegraphic communication is now restored between Bahia and Rio de Janeiro.

FRENCH ATLANTIC COMPANY.—On the 1st inst. the rates by this company's line were assimilated to those of the Anglo and Direct Cables.

SWANSEA.—The Swansea Corporation are using the Gower-Bell loud-speaking telephone between their offices and their water-works, a distance of about 14 miles.

THE TELEPHONE IN GERMANY.—According to a table published by the *Journal Télégraphique* there were in 1879 no fewer than 1,471 telephones in use in Germany.

THE TECHNICAL EDUCATOR.—The current number of this monthly contains an article by Mr. T. C. Hepworth on the telephone. The publishers are Messrs. Cassell, Petter, Galpin, and Co.

THE NEW MEXICAN CABLE.—The Silvertown Company's ss. "Dacia" will probably leave Silvertown on Tuesday next, with the first portion of this cable, and will be followed by the ss. "International" with the remaining portion about Dec. 15.

THE CONGRESS OF ELECTRICIANS.—The several Governments of the States comprised within the Telegraphic Union have already received diplomatic invitations to take part in the Congress and Exhibition at Paris next year.—*Journal Télégraphique.*

PARIS.—We understand that in the system of communication established between the President of the French Republic and the offices of the different Ministers, and the Chamber of Deputies and the Senate, the instruments used are the Gower-Bell loud-speaking telephones.

THE SOCIETY OF TELEGRAPH ENGINEERS.—The next meeting will be held at the Institution of Civil Engineers, 25, Great George-street, Westminster, S.W., on Wednesday, December 8, when a paper on "The Photophone and the Conversion of Radiant Energy into Sound" will be read by Mr. W. H. Preece, President.

THE HUGHES INSTRUMENT.—From a statistical table for 1879, published by the *Journal Télégraphique*, we gather that in the several European countries named the number of Hughes instruments is as follows:—In France 338, in Germany 177, in Austria and Hungary 75, in Italy 66, in Belgium 44, in the Netherlands (metropolitan office only) 29, and in Switzerland 21.

AN IMPROVED TELEPHONE.—Mr. John P. M'Dermott of Galveston, Texas, has patented an arrangement by which the telephone receivers are held, by means of a spring passing over the head, at each of the operator's ears, whilst the sending instrument is held by supports from the head piece against the mouth. The whole gives the operator very much the appearance of being in harness.

SALT LAKE CITY, UTAH.—Ogden, Utah, is the first city west of the Mississippi River to adopt the electric light. A flag staff sixty feet high is to be run up from the court house dome, giving an elevation of 200 feet, from which four lights of 3,000 candle-power each are guaranteed to abundantly illuminate a space one mile in diameter. The lights are to be in operation before the 1st of February.

BRUSSELS.—A correspondent writes that the Clerc and Bureau electric lamp is obtaining a considerable amount of success. The same engineers have designed a new dynamo machine which is now being tried. A public exhibition is to take place next week. The power required by the new lamp is said to be one h.-p. for a light equivalent to 75 Carcels; 1·5 h.-p. for 125 Carcels, and 2 h.-p. for 200 Carcels.

THE TELEPHONE IN SWITZERLAND.—The Swiss Telegraph Administration has decided to grant no more concessions for telephonic systems in towns, but to establish and construct them in future itself instead.—*Journal Télégraphique.* According to later information the Federal Council has resolved to establish a telephone service in the chief towns of the Confederation. The terms of subscription will be £6 a year.

COINCIDENCE.—The *Journal Télégraphique*, in an article on the conversion of electricity into mechanical power, draws attention to the similarity between the conclusions of M. Wiesendanger laid before the British Association, and those arrived at by M. Trouvé, both seeking to overcome by very similar means the loss of generated power in dynamo-machines at the moment the pole of the movable electro-magnet traverses that of the fixed magnet.

HELENSBURGH.—Is the borough to supply gas? Not long since the resolution was favourable, now there is a little hesitation. The mover of the resolution has withdrawn his support. He believes the electric light is making great strides towards perfection—indeed, he thinks it may be the light of the future. Another gentleman, while desirous that the ratepayers should control the gas supply, was also troubled with the bugbear of the electric light. Why should they give £30,000 for gas works which in a few years might be useless? Why indeed?

ITALY AND TUNIS.—Signor Cairoli, in the Italian Chamber of Deputies, stated the other day that the differences existing between the Governments of Italy and Tunis were now reduced to the question of establishing an Italian telegraph office in Tunis. The Government of Tunis refused to permit the erection of an Italian telegraph station, because it was under an engagement with a French company who had in their possession the entire telegraph system of Tunis, but the Italian Government insisted on the point, and hoped still to carry it to a successful issue.

ACCIDENT TO AN ELECTRIC LIGHTING ENGINEER.—The *Daily News* of 27th November states that while Mr. Nicholas was busy at a dynamo machine with one of the screws of the commutator, some part of the mechanism being imperfectly fixed, the current travelled in his direction, and passed through his body. He could not, of course, withdraw his hands, but he fainted away, and the weight of his falling body dragged him forcibly from the terrible hold of the machine. The electric spark followed his finger, and burnt it, but beyond this Mr. Nicholas seemed last night to be little the worse of his severe shock.

THE UNITED STATES.—The annual report of the Lighthouse Board for the last fiscal year will not be ready for publication for some time. It will probably contain an interesting report by Professor Morton in regard to the progress made by the electric light during the year. In order to give the electric light a proper test before adopting it for general use an appropriation of 50,000 dollars will be recommended to place one of the new lights in the Navesink Lighthouse, situated on the Highlands. Additional appropriations will be asked for to finish the lighthouse in Stamford Harbour, Conn. The matter of constructing new lighthouses will be left exclusively with Congress.

ELECTRIC LIGHTING OF THE CITY.—It is stated that the Brush lamps which are to illuminate Blackfriars Bridge, Ludgate-hill, St. Paul's Churchyard, &c., will be on posts not less than 13ft. high. Those of the Siemens system, which will embrace London Bridge, the Royal Exchange, Cheapside, &c., will be carried, the large lamps on posts 70ft. or 80ft.

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high, the small lamps on posts 20ft high. For the Southwark Bridge district, including the bridge itself, Queen Victoria-street, &c., the Jablochkoff lamps will be erected as at present seen on the Embankment. It would appear that the wires are to be carried overhead, a most unsightly, not to say dangerous, arrangement, in our opinion. It is expected that the systems will come into operation in February next.

Novel Method of Precipitating Rainfalls.—The *Scientific American* says:—"A patent has recently been issued to Daniel Ruggles, of Friedericksburg, Va., for a method of precipitating rain-storms, which, judging from a well-known precedent, is not entirely chimerical. It has frequently been noticed that heavy cannonading is followed by a fall of rain. Profiting by this suggestion, Mr. Ruggles has invented a method of producing a concussion, or a series of concussions, in the upper regions of the atmosphere, which he believes will induce rain. The invention consists in brief of a balloon carrying torpedoes and cartridges, charged with such explosives as nitro-glycerine, dynamite, gun cotton, gun powder, or fulminates, and connecting the balloon with an electrical apparatus for exploding the cartridges."

The Indo-European Telegraph.—A *Daily News* correspondent, writing from Meshed, in Persia, says:—"I greatly fear that our direct telegraphic communications with Europe are in imminent danger of being interrupted, for the line from Teheran passes through Tabreez, and thence to Tiflis. Should the Kurds push on to Tabreez—as is very likely—they will, of course, cut the wire. However, there still remains the line *viâ* Teheran and Bombay. I have already had occasion to mention the wretched state of the telegraph line between this and Teheran, as regards the state of the posts and insulators. The result is a constant interruption of communications with Teheran. From time to time whole days pass without it being possible to communicate with the capital telegraphically. For the past couple of days we have been in this position, and it is only this morning the line has again begun to work."

The "Scientific American."—Our contemporary, in its issue for Nov. 27, has a leading article on "Electric Lighting by Incandescence." It is certain that Mr. Swan's success had a little to do with "scratching the Russian," and it has not failed to rouse the dormant Tartar blood. Of course, the article more than hints that Mr. Swan has copied from Mr. Edison, that Mr. Edison was really the first to perceive success in this direction, or must we read the following in its primary meaning:—"It is not a little amusing, therefore, to witness the sudden conversion of these decriers of electric incandescence to a fervent belief in the applicability and economy of such a system of lighting simply by a single exhibition by an Englishman of what appears from the description furnished to be a close imitation of Mr. Edison's lamp, that is to say, the lamp which Mr. Edison, with characteristic effrontery, has been patenting as his own. As usual, it turns out that Mr. Edison has merely copied, with phenomenal exactness, an invention which an Englishman made years and years ago, but strangely neglected to make public until some time after Mr. Edison's alleged invention had attracted world-wide attention." We have more than once pointed out that dates have been named, and can with a little trouble be verified, which conclusively give Mr. Swan priority in conception and in realisation. He either gave a lecture two years ago in Newcastle, or he did not. The proceedings of the Philosophical Society will show the correctness of this.

The Electric Light and Telephony at the Nunnery Collieries.—In the winter season, when a large number of collieries producing house coal have to work double-shift in order to meet the demand for coal, one of the chief obstacles to be contended with is the difficulty of thoroughly cleaning the coals from impurities. To meet this the Nunnery Colliery Company have succeeded in adapting an arrangement of the electric light to the whole of their establishment of screens at the Soaphouse yard, where coals are loaded into trucks for railway sales and into carts. For some weeks past the two brilliant lights which have been observed by passengers arriving at the Victoria Station, Manchester, have revealed a number of workmen engaged in screening and cleaning the coal as it arrives at the depôt from the Nunnery collieries. The light given is very satisfactory, and proves an effective substitute for daylight. The position of the two lamps is so arranged as to throw the light directly on the coals as they pass from the screens into the trucks below. The lamps are fixed above the workmen. The light being thrown down directly upon the screens there is no chance of any dross or impurity escaping the eye of the screener. The lamps are said to have each a light of 5,000 candles. They are Crickie lamps, and the power is obtained from a small engine of five horse-power. The Nunnery Colliery Company have telephonic communication from one part to another through the whole of their works and between their head-office and the different depôts, while they are subscribers to the Telephone Exchange.

Locht's Pantelephone.—*Le Monde de la Science* states that Mr. M. L. De Locht, mining engineer, has perfected a very simple telephone, which transmits speech more clearly and with more power than any other modification of Bell's invention. The following is a description of the instrument:—"The Pantelephone is a microphone transmitter sensible to sonorous vibrations, the starting point of which may be several hundred yards away. It is composed of a movable panel carrying a carbon contact abutting on a stud of carbon or metal. This plate is made of aluminium or thin iron, or in fact any material of which a thin plate can be made. Its form is a square of $3\frac{1}{4}$ inches wide and about a 0·2 of a millimetre thick. It must be maintained as rigid as possible, and not liable to warp by changes of temperature or humidity. It is suspended by two very pliable little brass springs to a support projecting from an upright board which forms the frame of the instrument. In the middle of the lower side of the plate is rivetted a small disc of carbon which presses, the apparatus being suspended in a vertical position, against a little silver rivet on the end of a short strong spring fastened by a screw to a brass support. A hand screw in the same support allows the spring to be adjusted so as to cause the rivet to touch the carbon disc with more or less force. The pantelephone is placed in circuit with a battery, so that the current comes in at the brass springs that hang the plate, and passing through the contact of the carbon disc and silver rivet to the lower spring. It will be understood that the instrument is very simple, and can scarcely get out of order when once adjusted. It transmits all articulate or inarticulate sounds transmitted to it by means of solids, or which have air for medium and articulate speech, at sixteen yards distance. At $8\frac{1}{2}$ yards conversation is easily carried on, and without any effort, between two persons having each a telephone, and at four yards reading may be carried on without losing a word." It appears to us that this should be termed a modification of Professor Hughes's microphone, rather than a modification of Bell's invention.

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LESSONS FOR LEARNERS.

These lessons are written with the view of assisting those who, from various causes, are unable to obtain the aid of a master, and whose knowledge is not sufficiently extensive to enable them to use profitably the ordinary text books. A few days since I noticed one of the daily papers made the somewhat rash statement that nowadays masters were hardly required, and that books and books only were sufficient. My opinion is that no books can replace a good master, but that books may, under certain circumstances, form a convenient substitute. These lessons, then, are not intended to compete with a master's voice, but only to help those who cannot obtain the aid of a master.

This is our first lesson. You are a class of students expecting to hear of the wonderful and see something of the marvellous. There would be no difficulty in talking about, or showing you something you could not understand; my aim is to say as little as possible about that which is at present beyond your intellectual grasp, but rather to talk about the simple things you must thoroughly understand before you can hope to obtain even a fair knowledge of our subject.

You see I have a little apparatus which we are going to use, and I hope before long each of you will make similar apparatus for himself. These, in fact, are our tools, and not only must you see the tools, and know what they are for, but you must use them, use them constantly, for here as elsewhere "practice makes perfect." Our subject is "Electricity," and I intend to obtain the electrical current to be used in our experiments from this portion of the apparatus, which is called a battery. You see the battery consists of a trough of wood, containing a number of partitions.

FIG. 1.*

Each partition is partially filled with a liquid, and contains also two strips of metal, this one a strip of zinc (Zn) that one a strip of copper (Cu). You will notice also that the strip of copper in one partition is joined by a narrow ribbon of copper to the zinc in the next partition. We shall in future call each partition a "cell." The strip of copper in this end "cell" is connected to a screw called a binding screw, to which we can fasten a piece of wire. Similarly, the strip of zinc at the other end is connected to a binding screw. There is a good deal to be said about batteries later on, but at present we must rest content with what we can see.

Zn is a short way used in chemistry for indicating the metal zinc, and to the chemical student Zn not only means zinc, but it means 65·2 parts by weight of zinc; so, again, Cu is used to signify not only copper but 63·1 part by weight of copper. You must learn these symbols and numbers.

This other instrument, which we are going to use, is called a galvanometer, and is intended to indicate, so to speak, the strength of the electricity which passes through it in a given time. The needle you see will swing through a longer arc with a larger quantity of electricity passing through in a given time than with the smaller quantity. In future lessons we shall see that different galvanometers are used for different kinds of work.

Besides the battery and the galvanometer I have a number of pieces of wire, differing in material, in length, and in diameter, and a small cup half full of mercury (Hg. 200).

In Fig. 3, B represents the position of the battery, G that of the galvanometer, M that of the cup partially filled with mercury, W that of a wire.

One of the terminal screws of the battery is joined by a piece of copper wire to one of the binding screws on the galvanometer. A similar piece of wire connects the other terminal of the battery with the mercury in the cup. Previous to making these connections you will notice that I scrape the wire. I do this in order that the copper itself, and not the oxide of copper, which so soon tarnishes the lustre of the metal, should be brought into contact with the metal of the galvanometer and with the mercury. Unless experimenting to obtain information about the oxide coating to the metal, it is important that care be taken to make a *good* contact, and the contact made by the copper itself is better than that made by its oxide. This holds good also for

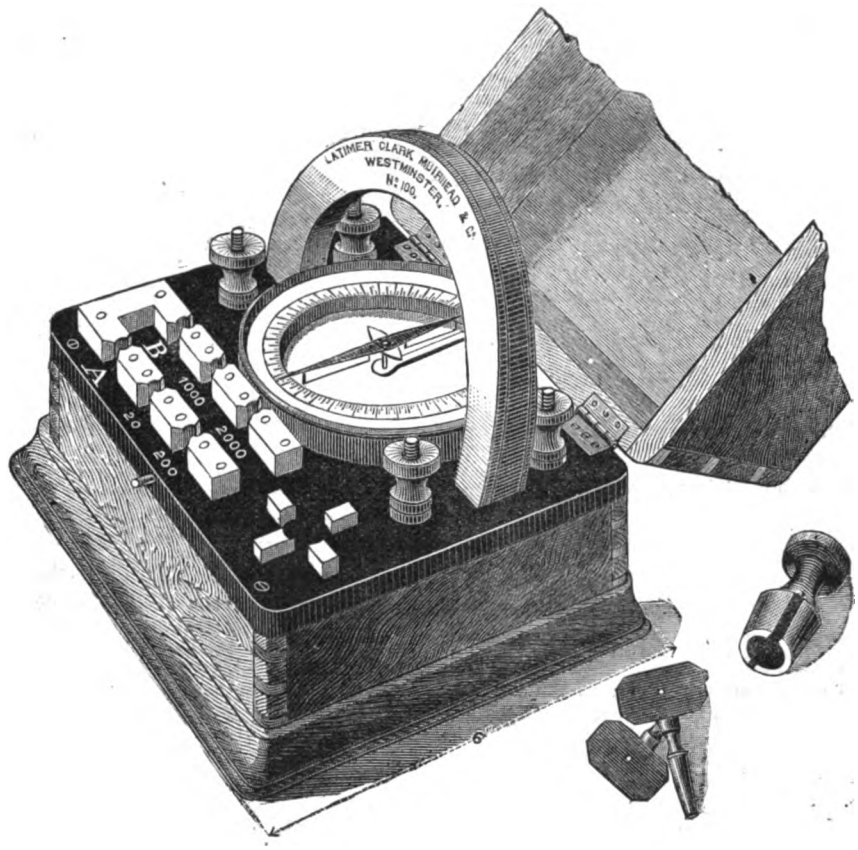

FIG. 2.

* Fig. 1 shows a form of Daniell's Battery made by Messrs. Clark and Muirhead, Regency-street, Westminster.

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most metals. It is to obtain good contact that I dip the free end of the wire C some distance into the mercury.

I now take the long piece of copper wire W (in future it will be understood that every attention has been paid to the making a good contact, and thus save constant repetition) and connect one end with the hitherto free binding screw of the galvanometer. You are watching the needle, but as yet you have observed no sign of movement. But look, as I plunge the free end into the mercury, the needle seems endowed with life, and every one looking perceives its action. It no longer points to zero, but has swung through a large arc. This is an effect of the action of that something we call an electrical current. I want you to notice particularly the position of the needle, and remember it during the whole of our experiments to-day.

FIG. 4.

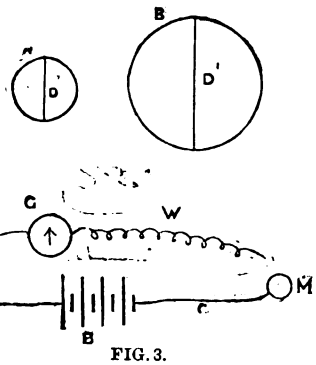

FIG. 3.

I raise the wire from the mercury, the needle rushes back, and after a few oscillations rests in its normal position pointing to zero.

I now take another piece of copper wire, which you see is exactly the same length as the one I have just used, but, as those near me can easily see, it is considerably thicker. We measure, and find its diameter just double that of the former piece. I weigh it, and find its weight is fourfold that used in the first experiment. This means that I have here four times as much copper as I had before, as those of you who know a little arithmetic can easily explain. These are enlarged views of the end sections of the wires. They are circular in shape—

You know that to find the area of a circle we *multiply the square of the radius (half the diameter) by* $\frac{22}{7}$ *or if greater accuracy is required by* 3·14159. This put into symbols may be represented by

$$r^2 \times \pi$$

where r is the radius, and $\pi = 3{\cdot}14159$.

Suppose the following cases

$$r = 1$$
$$r = 2$$
$$r = 4$$

then the areas of these circles would be respectively :—

$$1^2 \times \pi = \pi$$
$$2^2 \times \pi = 4\pi$$
$$4^2 \times \pi = 16\pi$$

So that doubling the diameter means increasing the area, as I have said, fourfold.

The piece of wire is now connected with the galvanometer, and on putting the other end into the mercury, we see the needle again starts into action, passes the former point, oscillates a little and comes to rest in a position far beyond that of the previous experiment.

Now, if we are playing football, and one man kicks the ball through a greater space than another, we do not hesitate to say why the ball goes further in the one case than in the other. If one man kicks harder, that is uses more force, the ball goes further; if it goes twice the distance in the one case as it does in the other, we say at once it was kicked with twice the force. We shall find many electrical phenomena similar to those arising from the flow of fluids. Thus, suppose I have a reservoir of water x feet high, connected to a channel by means of a pipe, and at the end of the pipe I have a valve, the pressure of the water may be balanced by a weight. If now I increase the sectional area of the pipe at the outlet fourfold and the valve fourfold, I shall have to use fourfold weight as a counterbalance. Let us keep these well-known facts in mind, and continue our experiments.

This piece of wire is the same length as in the previous cases, and, so far as I can measure, has the same sectional area as wire No. 2, but the shape of the section is almost that of a square. On replacing No. 2 wire by this, we see the needle swings to exactly the same point as in the previous experiment. I will replace this by another wire, still of the same length and area, but with a nearly triangular section, and again the needle swings to the same point.

We may stop for a moment and ask what of this? What do we learn from it? Think. In the last three experiments the length, and area, and material of the wire have not altered. Nor has the needle indicated any alteration in the current. The surface of the metal has altered. We may, then, conclude that so long as material, length, and sectional area remain constant change of surface has no influence on the current. We have learnt also that although material and length remain the same, if the sectional area be changed, there is a change in the current. We have now to see what effect change in length or change of material has upon the current. You remember the point to which the needle moved in our first experiment. Well, I have here a piece of wire of the same material and sectional area as in that experiment, but just twice the length. Connecting it with the galvanometer, and dipping it into the mercury, we see that the needle does not reach its previous point. I insert wires respectively similar to those in experiments 2, 3, and 4 in everything except length. We are now using wires of double the previous length, and in every case the needle fails to reach its former position; but we again notice in these experiments the swing is exactly the same for each wire, though differing in shape of section but not in area.

(TO BE CONTINUED.)

CORRESPONDENCE.

PROFESSORS AYRTON AND PERRY'S CRITICISM OF EXNER'S PAPERS ON CONTACT ELECTRICITY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: It must be admitted that there is some degree of inaccuracy in the theory put forward by Dr. Exner as at p. 285 of my translation of his paper, and more fully in a subsequent paper,* but the principle there indicated will, I believe, with certain modifications, prove correct. The chief modification is the substitution for the oxide film of a condensed compound gas film, one of the components of which has a chemical affinity for, and is in a position to combine with, the metal on which it is condensed, in consequence of which there is an E.M.F. at the surface of chemical action—a *Scheidungskraft*—which drives + E into the film, and — E into the metal. Supposing the film to be water and the metal zinc forming the the lower plate of a condenser, when the other condenser plate of platinum is placed close to this film and connected with the zinc, it is evident that a portion of the — E will flow from the zinc to the platinum in quantity depending on the ratio between the specific inductive capacities on each side of the + E on the film. The rudiments of this theory became very apparent to me from observation of my own experiments, and it is touched on in my second paper.† It was satisfactory to find afterwards that my view perfectly agreed with that of De la Rive,‡ published years before. With this modification, the points to which Professors Ayrton and Perry take exception disappear; for, remembering that what Dr. Exner measured was the *ratio* between the charge due to this chemical action and that due to the E.M.F of a Daniell cell, any variation in "the condensing arrangements employed" would cause both to vary in the same proportion, and, therefore, make no difference to the ratio between them. The inconsistency in the results of different observers, as I have before pointed out, is probably due to slight differences in the condition of the surfaces of the metals examined, or of the gas films on them, causing differences in the chemical action, and, consequently, in the observed E.M.F.

Respecting the criticism of the crucial experiment, is there any proof that a layer of silver chloride—supposing such did exist between the platinum wire and silver plate—would produce the observed effect? Besides, the fact that the difference of potential disappeared when the chlorine gas was replaced by dry air, though the silver chloride layer must still have been there, disproves this theory. Hoorweg adopts a quite similar explanation§, and says that the disappearance of the effect is due to the decomposition of the silver chloride by the light. Before making such an assumption, I think he should have assured

* "Zur Theorie des Volta'schen Fundamental-versuches," p. 16.
† *Phil. Mag.*, vol. vii., p. 111.
‡ "Traité d' Electricité," vol. ii., p. 776.
§ *Wied. Annalen*, vol. xi., p. 153.

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himself by experiment that it was true. I may add that I think in this experiment the chlorine probably permeated between the paraffin layer and the silver, as I find by experiment that, unless the chemical action is going on between the condenser plates, no effect is produced. Also, it is probable that the chlorine first combined with the hydrogen of the moisture film on the metal to form hydrochloric acid, which was afterwards decomposed by the silver—decomposition being necessary to the production of electricity by voltaic action.*

Professors Ayrton and Perry say that my own results in no way contradict the contact theory, and they apparently assume that the effect was due to the difference of potential at contact of the copper and copper sulphide formed on it. I have repeated this copper-iron experiment six times, and the effects are always the same, provided, of course, the experiment be properly carried out. On placing the copper-iron ring under the electrified needle in air, the usual "contact" effect is obtained—iron positive to copper. On admitting hydrogen sulphide gas, the copper becomes strongly positive to iron, but very soon *the difference of potential diminishes, and finally disappears* if the experiment be continued sufficiently long. In the description in my note book of the very first experiment with the ring, it is stated —"The deflections now fell so much in extent that they were unobservable, the copper having got coated with sulphide. When taken out, the copper was of a steel blue tint, the iron yellowish, but not much altered." The same effect of diminution is seen in the copper-nickel experiment in hydrochloric acid gas. This disappearance of the difference of potential while the metals are coated with their sulphides, and the hydrogen sulphide is still about them, appears to me to completely dispose of the assumption that the effect is due to "contact action" between the metal and sulphide. In fact, in air the iron is most subject to chemical action, and is positive; in H_2S the copper is most attacked, and is positive; when covered with sulphides neither is attacked, and neither is positive. If Professors Ayrton and Perry would repeat this copper iron experiment, which is not a difficult one to manage, they would, I am convinced, see that it cannot be reasonably explained by the contact theory.

Without offering an opinion on the merits of Dr. Exner's paper on the theory of inconstant cells, I may say that when Professors Ayrton and Perry state that he says the nature of the negative metal is indifferent, it would, I think, be only fair to add the rest of his sentence—"provided, of course, that it is not itself chemically acted on."

Finally, respecting the experiment on thermo-electricity referred to, on seeing it mentioned in a contemporary some time ago, I asked Dr. F. Exner about it, but was informed by him that he never made any such experiment. There are several other Exners at Vienna, one of whom may possibly have been meant.—Yours, &c.,

J. Brown.

Belfast, Nov. 24th, 1880.

THEORY OF THE MICROPHONE.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: From your issue of Nov. 6, I note that, according to experiments made by MM. Naccari, Pagliani and Dr. W. Siemens, pressure applied to carbon makes very little difference to its resistance, and the question is asked: What are the changes occurring at the microphonic contact during transmission of sound?

Permit me to state that for many months it has been held by me and several scientists of this City that the true microphonic action is *aerial*, viz: it takes place in the layer of air existing between the parts in contact, as it is well known that air is condensed on the surface of all substances more or less. Over a year ago, Mr. Moses G. Farmer proved by experiments that the resistance of a carbon contact can be raised to about a million ohm before actual break of the current takes place. I have myself at repeated times tested carbon contacts and found that a resistance of 20,000 ohm is easily attainable by means of a delicate arrangement. Dr. W. W. Jacques and Mr. J. H. Cheever, of our laboratory, have come to the same results. Another noteworthy fact is that a contact transmitter, consisting of a solid carbon diaphragm a quarter of an inch thick in contact with a carbon pin, both very rigidly clamped, forms the loudest and best transmitter known to us, but so sensitive is this instrument that the slightest pressure against the adjusting screw towards the diaphragm diminishes the volume of sound transmitted to a whisper.

The facts cited seem to indicate that it is the resistance of the air condensed upon the contact surfaces which undergoes these enormous changes of resistance, for the resistance of a standard Blake transmitter, as correctly adjusted, is about six ohm, and it is fair to suppose that with some sounds the resistance varies with each wave from five to 20,000 ohm, though articulation would be perfectly distinct if the difference would be only a single ohm. To completely displace the air existing between two substances in so-*called* contact with one another requires considerable pressure, and, therefore, in the loose joint of the microphone the air must offer a resistance to the current, small under light pressure, but enormously as this pressure is diminished. This does not necessitate an *arc*, since one cell of Leclanché, usually employed, would not produce it; but we may assume that in a contact transmitter the layer of air at the contact forms a highly elastic conductor or resistance medium.—Yours, &c.,

E. Berliner.

Laboratory, American Bell Telephone Company,
95, Milk-street, Boston, Nov. 18, 1880.

* Faraday "Exp. Res.," vol. i., p. 273.

THE ELECTRIC LIGHT IN THE CITY.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In a letter which appeared in your last issue, a Mr. Crompton favours the public with certain figures and estimates respecting the "Brush electric light."

Their very absurdity places them without the pale of argument, and in a controversy of this nature little is to be gained by simply meeting statement with counter statement, but I can assure the public that no figures have ever been put forward by Mr. Brush, or under his authority, as to the power of his light, which are not capable of absolute proof.

I am, as yet, quite unable to recognise in Mr. Crompton's position as a competitor in electric lighting any status sufficient to demand acceptance of a personal challenge; yet I am able to state that the Anglo-American Electric Light Company is willing in the interest of the general public to engage in competitive trials with all the existing recognised prominent systems of electric lighting upon the conditions which were suggested to the Glasgow Philosophical Society by our vice-chairman when we were invited to send our apparatus to the recent exhibition in that town. These conditions, if adopted in their entirety, would have gone far towards putting an end to rash and ill-considered statements. They were:—

(*a*) That the exhibition should be competitive as to the chief existing systems.
(*b*) That the tests should be comprehensive and exhaustive.
(*c*) That a full report should be published.
(*d*) That the points to be subjected to proof should comprise:—
1st. The candle power of lights exhibited.
2nd. The number of lights in circuit worked by a single dynamo-machine.
3rd. The guage and cost of wire leads.
4th. The length of circuit over which the current can be conveniently worked, and with what loss upon circuit of increased length.
5th. Indicated horse power per 1,000 candle power light produced.
6th. Cost per hour per 1,000 candle light produced as proved by consumption of coal and carbons, interest upon cost of apparatus, installation, &c.
7th. Evidence as to the working regularity, wear and tear of apparatus.
8th. Purity of carbons.

The end in view being to arrive at the cheapest and best electric light for general purposes of illumination.

I therefore take this opportunity of publicly stating that the Anglo-American Electric Light Company is prepared to expend the sum of £250 (or such greater or less amount as may be necessary, if the proprietors of the other prominent systems will bear their proportion of such total sum as might be required) towards carrying out an exhaustive series of tests, embracing the points above mentioned, the trials to be undertaken by a competent jury of not less than nine scientific men, the selection of whom shall be in the hands of the Council of the Royal Society, the Institution of Civil Engineers, and the Society of Telegraph Engineers, our competitors to be allowed to employ with their own dynamo machine any system of lamps and any carbons now in use in electric lighting (except the Brush), the Anglo-American Electric Light Company confining themselves exclusively to the "Brush" dynamo machines, the "Brush" single and circuit lamps, and the "Brush" carbons.

In conclusion, I cannot do better than repeat what was written by our vice-chairman when responding to the invitation of the "Glasgow Society" to exhibit there, viz., that such a work, if undertaken in a comprehensive form, and fully carried out, would be one of national importance, and worthy of all the scientific knowledge and investigation which could be brought to bear upon it; for electric lighting may be well considered as likely to be one of the greatest developments of the present day.

T. J. Montgomery.

—I am, &c.,

Anglo-American Electric Light Company (Limited),
74, Hatton-garden, London, E.C., Dec. 1.

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THE ELECTRICIAN.

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TELEGRAPHIC ARCHÆOLOGY.

It is but a truism to say that man is not perfect, his power finite, and his capacity limited. But what bounds shall be given to the imagination, which, the history of almost every science tells us, has so frequently foreshadowed the wonderful discoveries in the long distant future? This prescience has been singularly common in the annals of electrical science, and more particularly in the application to distant communication. Shakespeare would not be Shakespeare to the English mind could not an apt quotation be found for every subject upon which we write or speak. Of course, Shakespeare had the phenomenon of lightning in mind when he wrote of Ariel:—

> "now on the beak,
> Now in the waist, the deck, in every cabin,
> I flamed amazement. Sometimes I'd divide,
> And burn in many places; on the top-mast,
> The yards, and bowsprit, would I flame distinctly,
> Then meet and join."

And, of course, the idea put into the mouth of one of his creations of "girdling the earth in forty minutes" has done duty wherever and whenever telegraphy was a subject for writing. Some interesting and curious information relating to these inspirations will be found in the "Proceedings of the Literary and Philosophical Society of Manchester for 1877." Mr. H. Grimshaw directed attention to an old theological work printed in 1629, entitled "An Apologie of the Power and Providence of God in the Government of the World," &c., the fourth section of the tenth chapter of which treats of the use and invention of "the mariner's compasse or sea-card, as also of another excellent invention, sayd to be lately found out upon the loadstone," &c. This invention is thus described:—"Another excellent and secret conclusion upon this stone, pretended to be found out in these latter times, is, that by touching two needles with the same stone, they being severally set so that they may turne upon two round tables, having on their borders the alphabet within circle-wise, of two friends agreeing upon the time, the one in Paris, the other in London (having each of them their table thus equally fitted), be disposed upon certayne days and at certaine houres to conferre, it is to bee done by turning the needle in one of the tables to the *alphabet*, and the other by *sympathie* will turn itself in the same manner in the other table, though never so farre distant, which conclusion, if infallibly true, may likewise prove of good and great consequence; howsoever, I will set it down as I find it described by *Famianus Strada* in imitation of the stile and vaine of *Lucretius*:—

> 'Magnesi genus est lapidis mirabile,'" &c.

We, living more than 250 years later, are well aware that hitherto no such rude apparatus has been worked, and that such needles so suspended need a coil around them, connected by a conductor with the actuating current. The curious fact, however, still remains that to the onlooker several forms of instrument now in use present outwardly little deviation from this described by Strada. Addison, in the *Spectator*, No. 241, speaking of Strada, remarks upon "a chimerical correspondence between two friends by the help of a loadstone." Professor W. S. Jevons, in a more recent paper to the above-mentioned society, states that he, during investigations upon this curious anticipation of the telegraph, found numerous allusions to a magnetic telegraph in the scientific, and quasi-scientific works of the sixteenth and seventeenth centuries. Sir Thomas Browne, in his "Pseudodoxica Epidemica," says:—"The conceit is excellent, and, if the effect would follow, somewhat divine." Sir Thomas Browne, more practical than the poet, puts the matter to the test. He found that, though the needles were separated but half a span, when one was moved "the other would stand like Hercules' pillars." "Joseph Glanville," says Professor Jevons, "in his 'Sceptis Scientifica' (1665) discusses the objections of Sir Thomas Browne, and concludes:—'There are some hints in natural operation that give us probability that it is feasible.'" How can we read without wonder the words of Glanville of more than 200 years ago? "Though this pretty contrivance possibly may not yet answer the expectation of inquisitive experiment, yet 'tis no despicable item that by some other such way of magnetick efficiency it may hereafter with success be attempted, when magical history shall be enlarged by riper inspections; and 'tis not unlikely but that present discoveries might be improved to the performance."

Professor W. S. Jevons tried to trace these notions to the originator, but failed in his efforts. "Strada," he says, "attributed the invention to the celebrated Cardinal Bembo, the secretary of Leo X., but as Bembo (who died 1547) was a historian and literary character, it is hardly likely that he would originate a scientific conception of the sort. The earliest books in which I have found allusions to a magnetic telegraph is the 'Natural Magic' of Baptista Porta, pub-

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lished in 1589. In the seventh book he describes the 'wonders of the magnet,' saying in the preface, 'I do not fear that with a long absent friend, even though he be confined by prison walls, we can communicate what we wish by means of two compass needles circumscribed with an alphabet.' In the eighteenth chapter of the same book, he describes the experiment of putting a magnet under a table and moving thereby a needle above the table. This experiment, as Porta remarks, was known to St. Augustine, and an exact description will be found in his "De Civitate Dei," a work believed to have been begun A.D. 413. It seems probable that this passage in St. Augustine suggested the notion either to Porta, Bembo, or some early Italian writer. and that thus it came to be, as Sir Thomas Browne says, 'whispered thorow the world.'"

Who, however, after hearing Professor Graham Bell on Wednesday evening at the Society of Arts, so eloquently explaining his recent investigation, shall say that Strada's idea is incapable of realisation? Can the imagination grasp the future, when we are told that almost all bodies under the influence of an intermittent ray of light—nay, intermittent ray with light and heat stopped—ray of what we know not—give out a characteristic musical sound? Will the future archæologist see the germs of realities in the whisperings of the imagination put forth to-day?

PROFESSOR GRAHAM BELL AT THE SOCIETY OF ARTS.

The great pressure on our space this week, owing principally to the Telephone Trial, compels us to reserve our comments on the subject of Professor Bell's lecture to a future date. We may, without detraction from the value of Professor Bell's more recent paper, refer our readers to our issues of September 18 and 25 and October 2, which contain the paper read in America before the Association for the Advancement of Science.

THE ANGLO-AMERICAN ELECTRIC LIGHT COMPANY.

On Friday, the 26th ult., the Directors of the Anglo-American Electric Light Company invited several gentlemen interested in the subject of electric lighting to an inspection of their manufactory at Victoria Works, Vine-street, Lambeth. Amongst the directors were Sir Henry Tyler (the chairman), Mr. Sellon, Mr. W. Ladd, and Colonel Frederick C. Steuart, and amongst the visitors were Mr. W. H. Preece, Mr. Robinson (chief constructor at Portsmouth Dockyard), Captain Linden (naval *attaché* to the Russian Embassy), Mr. Spottiswoode, &c.

The works which were formerly the Victoria Iron Works are spacious, and the three floors were lighted by sixteen Brush lamps in continuous circuit, supplied with a current from a No. 7 Brush machine. The Company have up to lately been furnished from America with the machines necessary for the supply of their customers, but the London works are now sufficiently organised to turn out the machines complete here. The process of winding the armature and field-magnets was exhibited. A No. 7 machine, wound specially for a single light, instead of for 16 lights, was exhibited, driven by a Brotherhood engine, at 750 revolutions a minute, and giving a light asserted to be equal to 50,000 candles. In this machine the armature is wound with the same size wire as the field magnets, about No. 13, and the field magnets are wound in three coils, joined in parallel circuit. The work in the factory was going on entirely under the light of the electric light, and it was stated that the workmen are perfectly satisfied with it, and this we can quite believe from our own inspection. The company seem certainly to be pushing ahead in a business-like way in thus starting and organising a factory which will be able soon to turn out machines for their customers without indenting on America. After an inspection of the works, and the large light, which is intended for one of our ironclads, the company were driven in omnibuses along the Thames Embankment to compare the light by the Brush system with the Jablochkoff lights on the Embankment, and from thence to the Liverpool Street Station, lit by the company by the Brush system, and here the lighting seemed certainly excellent, and all that could be desired. The company afterwards were the guests of the directors at a dinner in Spiers and Pond's rooms at the Liverpool-street Station.

PHYSICAL SOCIETY—Nov. 27.

The Photophone.

Professor Graham Bell exhibited his photophone, and explained the apparatus employed by Mr. Summer Tainter and himself for transmitting sounds by a beam of light. The form in use consists of a metal plate or mirror vibrated by the sound, and reflecting a beam of light to a distance, where it is focussed on a selenium cell in circuit with a telephone and battery. The light undulates in sympathy with the vibrations of sound, and alters the resistance of the selenium in accordance with the vibrations, thereby reproducing the sound in the telephone. The electric light used was too unsteady to give articulate speech, but by means of a rotating disc, perforated round its rim with holes, the light could be occulted in such a manner as to give an audible note in the telephone. Different varieties of receivers were described, some of which have not yet been tried. One of these consisted in varying the rotation of the plane of polarisation of the polarised beam. Another plan for transmitting the beam consists in making the vibrating plate vary the supply of gas to a jet or manometric flame. The farthest distance speech has been heard by photophone is 800 feet, but, theoretically, it should operate better the greater the distance between the mirror and selenium. On interposing a sheet of hard rubber in the ray the invisible rays passing through it convey the sounds in a lower degree, and sounds can be heard by replacing the selenium receiver by discs of different materials, such as hard rubber, metal, &c.. and simply listening at them. All substances appear to possess the power of becoming sonorous under the influence of varying light. Hard rubber, antimony, zinc give the best effects; paper, glass, carbon the worst. Even tobacco smoke in a glass test tube held in the beam emitted a note, as also did crystals of sulphate of copper. When hard rubber was simply made into the form of an ear-tube and held in the beam, the audible effect was also produced; and, in fact, when the beam was focussed in the ear itself without any other appliance whatever a distinct sound could be perceived.

Mr. Shelford Bidwell also exhibited a lecture photophone, in which the reflector for receiving the light was discarded, and the beam focussed on the selenium by a lens. The two lenses used cost only 25s., and the beam was sent 14 feet. The selenium cell was made by spreading melted selenium over sheets of mica, and then crystallising it by heat. For mica Professor Bell recommended microscopic glass. The resistance of the cell was 14,000 ohms in the dark, and 6,500 in the light. Speech was distinctly transmitted by this apparatus. Mr. J. Spiller thought that since selenium was probably alloyed with brass and the baser metals, it would be better to use gold and silver for the cells; but Professor Bell said that he preferred brass, since (perhaps for the reason that Mr. Spiller gave) it yielded the best results.

THE TELEPHONE CASE.

On Monday, the 29th, the long pending case between the Attorney-General (acting for the Postmaster-General) and the Edison Telephone Company, of London (Limited), and the Telephone Company (Limited), was heard in the Exchequer Division of the High Court of Justice at Westminster Hall, the judges being Mr. Baron Pollock and Mr. Justice Stephen.

Edison's loud-speaking telephone and Bell's telephone were in connection with the court from the Palace-chambers Exchange, and a number of Post Office apparatus (including Wheatstone's transmitters, sounders, Reis' telephones, made by Mr. Stroh) were fitted up on a table running in front of the judicial bench.

The Government case was that telephone messages shall be called messages; that the defendants should be restrained from taking money for messages; and that an account should be kept of all messages sent by the company.

The Attorney-General then reviewed the various Acts passed from time to time anent the Government monopoly. He first quoted clauses in 17th of Victoria Act, enjoining the railway companies to open their lines to the public, and the 24th and 25th of Victoria of 1861, defending telegraph lines from injury. He then passed to the Acts bearing more particularly on the case, beginning with the Act of 1863, which is a general Telegraph Act, giving power to the telegraph companies in existence to enter on certain lands. The next Act, that of 1868, recommended that the Postmaster-General should acquire by agreement and purchase the whole or any part of the electric telegraphs existing in the country, including the wire, posts, works, and instruments. It, therefore, only gave limited power and purchase by agreement; the important Act was that of 1869. These Acts were both passed in the interests of the public to give them cheaper telegrams. The 1869 Act gave the exclusive privilege to the Government of transmitting telegrams. The term telegram was defined as any "message or communication and transmitted by a telegraph." What, then, is a telegraph? The term telegraph, in addition to its definition in the 1863 Acts, shall mean and include any message, or other communication by means of electric signals. In the 1863 Act a telegraph is defined as "wire or wires used for the purpose of telegraphic communication with any casing, coating, tube, or pipe, enclosing the same, and any apparatus connected therewith, for the purpose of telegraphic communication." The Attorney-General pointed out that there was no mention of electricity in the definition, but referred to the

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posts, wire, or wires, and any apparatus employed therewith for telegraphic communication. The Act was evidently meant to refer chiefly to electric telegraphs, and to include all the apparatus then known. The 1869 Act supplemented the 1863 Act, which limited the telegraph to wires, by allowing for a telegraph without wires at all, and defines an *electric* telegram. Reference was then made to the exceptions in the Act, as in the case of messages for business purposes on private wires in works, &c., without any charge, and the case of railway companies; and the power of licence given by the Postmaster-General. It was then submitted that the defendants had erected wires and sold messages, thereby committing a breach of the Act of 1869. The plea of the defendants was then stated, the chief being that they do not transmit *messages* under the meaning of the Act. The Attorney-General then considered the question of the Postmaster-General's rights as acquired by money. He acquired the means of transmitting all messages sent by wire or otherwise by means of electricity, and he submitted that the Telephone Company was infringing this right. The plea of the company was that their communications are not telegraphic at all, not because electricity is absent, but because the telephonic action is new. The Attorney-General then narrowed the case to the question whether a mechanical means which gave a more sensitive interpretation of the current employed could upset the whole monopoly; and likened the contention of the company to a person who invented the pneumatic despatch upsetting the postal monopoly because only mail coaches or trains had previously been employed for transporting letters. He held that the Act included all the improvements which might be effected in working the telegraph, but disclaimed any attempt to repress inventors, the motive being to protect the revenues. There is, the Attorney-General said, a floating idea that a telephonic message was not a telegram. As regards the etymology, he held that the word telegraph meant a means of communicating intelligence. Mention is made in Mr. Sabine's affidavit of a telegraph, which was a semaphore arrangement, described in the *Gentleman's Magazine* for September, 1794. Sir W. Thomson, who appeared for the defendants himself, in the *Encyclopædia Britannica* of 1860, defines a telegraph as the interchange of ideas by means of the inanimate matter between them. There was nothing in a telegram to limit it to mere writing at a distance.

Mr. Justice STEPHEN here remarked that these considerations were very interesting and curious, but they seemed to him a little wide of the mark. The whole case was confined to the question whether the telephone was a telegraph *as defined by the Act of* 1863.

The ATTORNEY-GENERAL, after pointing out that actual writing telegraphs were really a recent invention, then passed to the question whether a telephone came within the meaning of the Act. To decide the question, he described the means employed in telegraphing before the telephone. He defined the essential elements of the telegraph to be electricity, conductor, and variation of the current; and maintained that in the telephone only these elements entered. The variations of current appealed to almost all the senses, and all the senses could be affected by the variations of current. Had an inventor found a means of appealing to another sense, would he thereby upset the Government monopoly?

Mr. Justice STEPHEN: They have taught it to *talk* instead of ticking.

Mr. Justice STEPHEN here again interrupted with the remark that though very interesting these considerations would hardly be disputed by the defendants; and pointed out that as the three elements of charge, wire, and disturbance were common to both telephone and telegraph, the case must reduce itself to the mechanical means for interpreting the disturbance.

Mr. Baron POLLOCK said that a man might use a spoon for eating peas, and another apply it to eating beans, and there would be little distinction, but there might come a third man who would find out some harmonic property in the spoon, and use it for a tuning fork.

The ATTORNEY-GENERAL resumed by referring to Morse's instrument, describing the Morse key for totally intermitting the current, and showed that other variations could be produced.—The defendants' counsel here remarked that the Morse key does not produce *variations*, but *interruptions*.—The Attorney-General stated that there was no difference except in degree between variation and interruption. He referred to a patent specification by Sir W. Thomson (1858) for an A B C instrument, in which varied currents were employed. In Varley's 1870 patent for a telephone undulations of current were superposed on the ordinary signals. Sir Charles Bright also in his affidavit mentions a means of increasing and decreasing currents for working cables before the telephone was invented.—The defendants' counsel here said that he only implied that the Morse key produced interruptions, not variations—and the Attorney-General maintained that there was no difference between them in principle. The action of the Morse instrument was next explained, and the ticking of the "sounder" was shown to communicate intelligence by *signals to the ear*. If the interruptions were sufficiently rapid the sounder would produce a musical note; and if it could be made to produce a word, what is the difference?—Mr. Justice Stephen pointed out the difference was that in the one case the word "and" would be spoken, and signalled in another.—The Attorney-General said the whole difference lay in the different ways of expressing the sound.—Mr. Baron Pollock pointed out in one case you may affirm that the *sound* is transmitted, and in the other case you cannot say it is.—The Attorney-General submitted that the sound was not transmitted as if it were put into a pill-box and sent along a pipe. In alluding to the recognition of the speaker's voice in the telephone, the Attorney-General said that the Morse clerk could also tell who was sending the message by the manner of the ticking. [The interruptions of the current by other than manual means, *i.e.*, by an automatic key, was then illustrated, and the rise of pitch of the musical note given on the sounder by the interruptions was rendered audible. The production of notes of different pitch from a vibrating diaphragm of Mr. Stroh's construction was then shown, and Helmholtz's discovery, that the vowel sounds could be produced by combining different notes, was shown by Mr. Stroh's automatic phonograph.] These sounds, the Attorney-General pointed out, were produced by the vibration of a plate, and that this plate could be vibrated by means of electricity.—[The Edison phonograph was then exhibited by Mr. W. H. Preece, and made to say a few words and utter laughter.]—Variations in the current could be produced by the phonograph and the words transmitted. The Attorney-General then reviewed the different means of varying the current, including the vibration of the air. The Wheatstone automatic instrument with the punched slip was also exhibited in action, producing the variation in the current. The Attorney-General then called attention to the Hughes printer, which required no receiving clerk, like the Morse, as the message is actually printed by the receiving instrument. The copying system is automatic at both ends, as improved by Caselli in 1865 and D'Arlincourt in 1879. No skilled operator is required to produce this result, any more than for the telephone.—The defendants' counsel again interposed with the remark that the D'Arlincourt produced interruptions, not variations, and the Attorney-General held that the point was immaterial. It was, he said, preposterous that the monopoly of the Government should be infringed on such slight grounds. [Mr. E. A. Cowper's writing telegraph was next exhibited, as producing its effects by means of variations of the current strength, requiring no skilled operator, and unknown in 1869.] Mr. Justice Stephen here remarked that this was the only literal telegraph.—The Attorney-General submitted that Cowper's telegraph had every element in common with the telephone, and therefore equal grounds for infringing the rights of the Crown. The Edison Telephone Company went to work under the English patents of 1877 and 1878. What did Mr. Edison think of his own invention? He defines it in his patent specification as an instrument for the transmission of electric currents, and the reproduction of corresponding sounds at a distance. This the Attorney-General affirmed was simply a definition of the electric telegraph; and in another claim of his patents he actually calls it a "telegraph operated by sound." [The nature of Mr. Edison's telephone was then explained by the Attorney-General, and it was shown that electricity is the means used in *reproducing* the voice, not actually transmitting it, and that an operator was necessary to turn the handle of the receiver]. His lordship understood that though it was not the same sound it was repeated so well that the voice could be recognised.—The Attorney-General said that it was masked by a slightly Punch and Judy twang.

Mr. Baron POLLOCK: "Ah yes, you can distinguish between the voice of Punch and Judy."

The ATTORNEY-GENERAL then turned to the receiver of Bell, and argued that no difference between it and the Morse sounder existed in principle, and that in the Edison telephone the difference was so slight as to be of little consequence in connection with the case. The hearing for Monday then closed.

On Tuesday the case was resumed.

The ATTORNEY-GENERAL began by remarking that in Sir W. Thomson's affidavit he states that when the Telegraph Act was framed no one living foresaw that speaking by telegraph would ever be invented. But this statement is not true to fact. [Mr. Justice Stephen here said that there was a great deal in the affidavit beside the issue.] In Count Du Moncel's work, published in 1855, a device for transmitting speech by electricity is suggested. The principle of the telephone is demonstrated, and I will show that Mr. Edison in a book of his own states that he has borrowed the idea of a telephone. In 1860 Phillip Reis invented the basis of the telephone, which was shown in court and described. This apparatus contains the principle, and Mr. Edison has simply taken it and made the telephone from it by mechanical improvement. He borrowed the very name from Reis. [Their Lordships here remarked that all this argument about the development of the telegraph was beside the case. Had the telephone never entered the human mind when the Act was framed it would not matter. The question was not what instruments were invented before the Act, but whether these telephones came within the Act.—The Attorney-General resumed by citing a passage by Reis, in which he says he has often heard the tune of "God save the Queen," and wished to know what was the difference between speaking words and hearing them sung, but the defendants' counsel pointed out that it was only the *tune*, not the words of the song which Reis heard. The Attorney-General maintained that the principle was identical in both cases, and then proceeded to discuss the liability of the company as a corporation doing public business. Sometimes they hire out telephones, they possess telephonic exchanges, sending public messages among themselves, and sometimes they sell a wire connected to one of their stations. The process of sending telephonic messages was then described by the learned counsel, and it was contended that these exchanges were an infringement of the monopoly. [Mr. Lymington's exchange in Glasgow was then referred to, and the Attorney-General held that the question whether he infringed the monopoly was apart from this case].

[The affidavits of Mr. Preece, Sir Charles Bright, Mr. Latimer Clark, Professor Hughes. These defined the term "telegraph," and illustrated it by examples, maintaining that a telephone is for all practical purposes a telephone, Professor Hughes pointing out that the line wire insulation and electric currents are elements absolutely necessary for the working a telegraph, but the transmitting and receiving apparatus may be changed. The affidavit of Mr. W. H. Barlow, inventor of the logograph, was then read, and the logograph explained. Mr. Warren de la Rue's affidavit gave a description of Reis' telephone].

The Defendants' counsel read an affidavit by Mr. Bouverie stating that the company was originally formed for private communication, not for sending public messages. It is not, and never has been, formed for sending public messages. The business conducted by the company is as follows:—The company leases for an annual rent to a private person or corporation the telephones and call bell. The party must either possess a private wire or arrange to have one erected by the company. When a considerable number of people in one neighbourhood desire to communicate the exchange system is adopted to reduce the length of wire to be used. Forms of agreement accompanied the affidavit of Mr. White, the secretary of the company. An annual rent is charged for the use and maintenance of the instruments. The humble petition of the Telephone Company was then read, setting forth that the company had expended large sums of money in providing their system. The owners of the Bell telephone had offered the Postmaster-General to supply telephones to him for public use, provided that 60 per cent. of the profits should revert to them, the owners. The company had connected Baron Reuter's office with *The Times*, to enable Reuter's telegrams to be dictated to the compositors. The House of Commons had also been connected to *The Times* office for same purpose. Sir W. Thomson, in his affidavit, says that when he wrote the passage in the *Encyclopædia Britannica* cited he did not dream of a telephone which could speak. Reis' musical toy was not in any sense a speaking telephone, but an instrument based on Page's earlier discovery. All telegraphic instruments prior to the telephone communicated

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intelligence by means of *signals* or musical notes. Professor Stokes in his affidavit agreed with Sir W. Thomson, and considered that the telephone was so novel an invention as to be regarded as not coming under the Act. That was a question for their lordships. Professor Tyndall, in his affidavit, said that he considered the telephone different in kind from the ordinary telegraph. To confound the telephone with the telegraph would be to place in the same category utterly dissimilar things. Professor Gladstone understood a telegraph to mean a device for transmitting thoughts by means of a *code of signals* beyond the reach of hearing. He understands that an artificial mode of transmitting the human voice is not a telegraph. Whatever the kind of apparatus varies in the telegraph the message is still by *signal*—for example, the sounder gives audible *signals*, not speech in any sense. Reis' telephone could only have been employed in telegraphy by means of a pre-arranged *code of signals*. Bell and Edison telephones are scientific novelties, which involve new principles. Professor Foster considered the telephone as distinct from a telegraph. In all cases of sound telegraphs the sound is created at the receiving end, and bears *no* resemblance to a sound produced at the transmitting end. The telephone rests on two distinct discoveries. Before it none knew that a solid body could take up all the minute variations of the voice, or that an electric current could be modified, so as to take up all these variations. It is based on physical knowledge which did not exist prior to 1869. Dr. Fleming in his affidavit pointed out that Reis' telephone did vary the strength of the current. In Edison's telephone the current was varied, and the battery current did not enter the wire at all. It was an induced current which entered the line, a condition that did not enter into the Attorney-General's definition of a telegraph. According to Mr. Preece's affidavit a speech is a telegraph which is manifestly absurd. [Mr. Baron Pollock put the argument as follows :—If a person could find a particular tube which could carry the voice 500 yards it could not be considered a telegraph.] Baron Reuter, in his affidavit, says that had he been required to define a telephone prior to 1869 he would not have described it as a telegraph. Mr. Symington in his affidavit said that in 1875 he established an exchange with A B C instruments in Glasgow between private parties, and worked for several years. This exchange system is adopted by the telephone companies. Proceedings were taken by the Government, and my solicitor advised me that it was no infringement of the Post Office monopoly. No further notice was taken of the system by the Government after 1875. The Edison Telephone Company bought up Mr. Symington's exchange, which still exists in its original form. Moreover, an opposition clause in the Act for 1878 likely to interfere with telephone work was withdrawn. The Attorney-General then took up the case, quoting from the speech of Sir W. Thomson at the British Association in 1876, where he calls Bell's telephone the most marvellous of all the marvels of the electric telegraph. Mr. C. Varley in his affidavit affirmed that he long ago carried on experiments with a Reis telephone which led him to believe that it was possible to transmit the human voice. Other affidavits were cited, including Sir George Airey's, who considered the telephone a telegraph, and Mr. Spottiswoode, who considered the telephone also a telegraph. The defendants then cited the affidavit of Lord Rayleigh, who quoted the definition of Mr. Preece in his work on the telegraph as a good one. The definition in question specified the use of preconcerted signals. Mr. Hopkinson in his affidavit confirms Lord Raylegh's view. This concluded the hearing of the case on Tuesday.

On Wednesday the SOLICITOR-GENERAL, at the sitting of the court, proceeded to sum up on behalf of the Crown, and in doing so urged that the means of communication in the telephone came within the definition in the Act, 1869, of a telegraph, which included any apparatus for transmitting messages or other communications by means of electric signals. The contention of the defendants would, if successful, lead to the startling result that the railway companies would be able, by simply changing from the Morse to the telephone transmitter, to evade the monopoly which had been purchased by the Government on behalf of the public.

The Defendants' Counsel maintained that the telephone was in no sense a telegraph communicating by means of *signals*, and that it came within the exception of the Act permitting private persons to own or lease a telegraph for their own private business. Public messages are not sent by telephone, but two or more co-owners of a telephone wire employ it for their own private business. The Crown would allow a merchant to communicate with his clerk for business purposes by a telephone line, but wishes to stop him from communicating with his stockbroker. The telephone business does not properly interfere with the postal telegraphic business at all. The Central Exchange is merely a device for economising wire.

Mr. BENJAMIN here took up the case, and reverted to the scientific questions which had been raised, and the attempt which had been made to depreciate the value of the invention of the telephone. The Attorney-General yesterday stated that Mr. Edison had made the telephone practicable by a *mechanical improvement*, but this success was chiefly due to the discovery that the strength of current varied with the degree of intimacy of contact of the carbon in the transmitter. The Company had only acquired the right to use his telephone, and though Mr. Edison included a number of things in his patent with which we have nothing to do, we are not to be responsible for these things. The Attorney-General had tried to make out that we were simply using an improved form of Reis' transmitter, but Reis' invention was constructed on a different principle, as was shown in affidavit. Mr. C. F. Varley, witness for the Crown, says in his affidavit that he did not succeed in reproducing the human voice, though he had tried for years. Reis' telephone was not on the same path of research as Edison's instrument. Sufficient justice has not been done to Edison's invention. Again, the extract from Du Moncel's work of an anticipation of the telephone, according to Dr. Hopkinson's affidavit, only shows that the true principles of a speaking telephone were not yet apprehended. The language of an Act of Parliament must be construed according to its meaning at the time. In 1869 there were a number of telegraph offices to which persons came and wrote messages which were transmitted by a code of signals. With all their apparatus none could speak, and the power of speech was absolutely unnecessary in all the operations of telegraphing. All telegraphs prior to the telephone had to spell out their messages. It is no argument to say that Mr. Reis and other men were on the *verge* of this great discovery of the telephone. They did not attain it. The telephone is a new commercial article. It touches a class of persons who would not have availed themselves of telegrams at all, owing to the trouble of going to an office and writing and waiting. It enables them to converse without the necessity of going to see each other. A solicitor residing near another might telephone to another, but he would not dream of telegraphing to him.

On Thursday Mr. WEBSTER continued his argument on behalf of the defendants, and in doing so again reminded the Court of the great improvement and difference which existed respectively in favour of the telephone, and between the telephone and the ordinary telegraph instrument. Before the telephone came into operation there had been no means of transmitting the human voice, or of enabling the human voice to act upon a transmitter, and originally the sound which was the means of conveying a message operated solely and entirely at the receiving end of the wire. Those difficulties had been overcome by the use of the telephone, and thus a vast improvement and difference had been effected in the science of telegraphy. While dealing with this view of the case, however, he protested against a monopoly being decided by delicate scientific questions. He was obliged to plead with it owing to the course pursued by the Attorney-General, but he nevertheless submitted that the real ground upon which the Court should act was the construction of the Act of Parliament, and that it could not for a monent be contended the words "message" and "telegraph" applied to the result delivered by the defendants' telephone. If the Crown succeeded it would obtain a monopoly over speech, and surely such a result could not have been contemplated by statute.

Mr. Justice STEPHEN: The question is not simply what construction was put upon the words of the Act of Parliament when it was passed, but what construction would have been placed upon them if the telephone was then known.

Mr. WEBSTER: That is so, and I am not afraid to deal with that position. I say that the word "message" would be inapt for the purpose of signifying communication by telephone.

Mr. Justice STEPHEN: That is exactly the question at issue between you, as the Attorney-General says, on the other hand, that the word "message" is perfectly apt for the purpose.

Mr. WEBSTER then reviewed the Acts of Parliament in support of his contention.

Experiments were conducted in court with the defendants' telephone and switch-board, during which the wires Nos. 1 and 2 were connected, and communications carried on. A message was also transmitted to their lordships from the Palace Chambers, Westminster.

Mr. WEBSTER stated that the proceedings in court had been heard at the Exchange.

Mr. Justice STEPHEN: Then we are liable to be impeached [laughter].

Mr. BENJAMIN further addressed the court, and the case was again adjourned.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Dec. 1.		Business Done Week Ending Dec. 1. Highest.	Lowest.
Anglo-American Ordinary	65½,	¾	64¾	61½
Do. "B"	94,	½	93½	91
Do. "A"	36½,	¾	36	32½
Brazilian	9 13-16,	15-16	10	9¾
Cuba	8¾,	9½	9½	9
Do. Ten per Cent. Pref.	16,	½	16	16
Direct Spanish	2½,	3½	—	—
Do. Ten per Cent. Preference	12½,	13	12¾	12¾
Direct United States	12½,	¾	12¾	11¾
Eastern	9¾,	¾	9¾	9 11-16
Do. Six per Cent. Debenture	102,	106	104	104
Do. Five per Ct. do. 1699	104,	107	105½	105
Do. Six p Ct. Pref	12¼,	¾	12¾	12¾
Eastern Extension	10 1-16,	3-16	10½	10
Do. Six per Ct. Deb	108,	111	109	109
German Union	10,	½	—	—
Globe Telegraph & Trust	6 11-16,	13-16	6¾	6½
Do. Six p Ct. Preference	12½,	¾	12¾	12
Great Northern	10¼,	11¼	11	10¼
Indo-European	25,	26	24¾	24¾
Mediterranean Extension	2¾,	3¾	3 1-16	3 1-16
Do. Eight p Cent. Pref	10¾,	11¾	11	11
Reuter's	10¼,	11¼	—	—
Submarine	255,	265	—	—
West India and Panama	2¼,	¾	27-16	1¼
Do. Six per Cent. 1st Preference	7	¼	7¼	6¾
Western and Brazilian	8¾,	¾	9 3-16	8 11-16
West. Union 7 p. Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	104,	107	—	—

TRAFFIC RECEIPTS FOR NOVEMBER, 1880.

Companies.	Nov., 1880.	Nov., 1879.	Increase.	Decrease.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	—	—	—	—
Direct United States Telegraph Company	—	—	—	—
Direct Spanish Telegraph Company	—	—	—	—
Eastern Telegraph Company	47,669	46,147	1,522	—
Eastern Extension Telegraph Company	29,724	26,379	3,3	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of Amer'a Telegraph Company	—	—	—	—

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ABSTRACTS OF SPECIFICATIONS.

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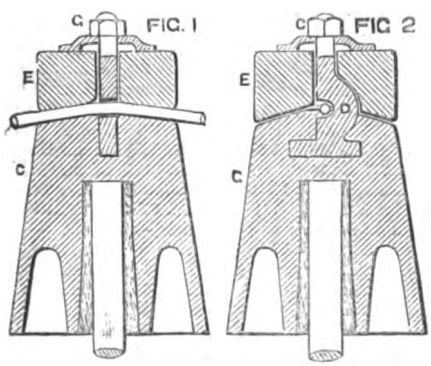
We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts—Ed. *E.*]

1503. Improvements in and Machinery for the Production of Matrices for Stereotyping and Electrotyping, dispensing with the Setting of Type, *G. D. Macdougald, W. Adie, G. R. Adams, and P. Fleming.—Dated 12th April.* 1*s.* 4*d.*

The object of this invention is to stamp the matrices for stereotyping, &c., without the labour and trouble of setting up the type. As an auxiliary a machine is necessary to perforate a slip of cardboard or paper according to the types that are to be liberated in the machine. In the perforating machine the operator depresses the requisite key, by which means a plate is pushed into a gap between a corresponding lever and rail, which is swung on two levers, turning on centres. The rail extends along the whole range of levers, and is actuated by electro-magnets. On depressing the key a rod is raised making electrical contact, and causing one magnet to draw the other, bringing forward the rail to come into contact with the depressed plate, while a lever is pressed forward and the hole is punched. The stamping of the matrix is effected by a machine consisting of two parts, one carrying the types and matrix, the other carrying forward the strip of punched paper. The mechanism is regulated so that the tubes carrying the types converge to a point where the matrix is to be stamped. The perforated paper passing over a roller allows puffs of compressed air to actuate the right portion of the mechanism and carry out the operation desired.

1510. Insulators, *G. Wells and A. Gilbert.—Dated 13th April,* 1880.—(*Not proceeded with*). 4*d.*

The insulator is so formed that on the breakage of the wire between any two posts the other part of the wire is securely held. The insulator consists of two parts, both having a semicircular groove in which fits the wire; and the top part, or cap, passes over a bolt secured to the bottom

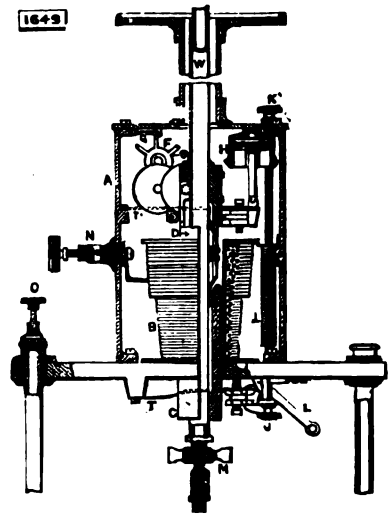


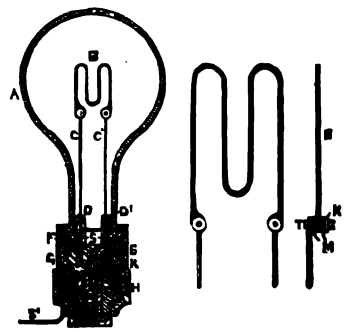
part, and is held in place by a nut, its under surface bearing on the wire so as to hold it securely. The part, C, of the insulator has embedded in it a screw-bolt, D. The wire is laid in the groove made for its reception between the two parts E and C, which are securely held by the nut G.

1649. Electric Lighting Apparatus and the Manufacture of Carbonised Material for Conductors, *W. R. Lake.—Dated 21st April,* 1880.—(*A communication.*) 8*d.*

The first part of this invention is to obtain a more sensitive arrangement of the regulator portion of the clockwork part of electric lamps. Mr. Maxim removes all friction from the regulating device by suspending the working part upon springs, which at the same time support the upper carbon and its feeding mechanism free from contact with all other parts of the lamp. Then, to enable the carbons to be more easily adjusted, the side rods of globe-holder are made telescopic. In the figure A is the case containing the mechanism, B is a coil, C the iron core of B, while D is a brass extension of C. The clockwork train is carried by D. T1 T1 and I are springs carrying C and D. A star wheel, F, carries fans, which may engage the detent G. The clamp H controls the movements of the parts. The spring I is hung on adjusting screws J and K, of which J is attached to a projecting arm of the magnet core K to the case. A combined hook and lever, L, pivotted to case, engages the projecting arm and holds up the parts in connection. N is the positive, and O the negative binding screw. The current goes from N, through coil B to case A, and to upper carbon-holder. This carbon-holder is carried by a spindle, W, passing through C and D, and ends in a ball-and-socket joint, with part of the socket formed of a nut, M, to fix the position of the carbon. W has on one side a rack to engage a pinion of the clockwork train: Now, C and D have a free vertical motion within B, and as C is a little below B, the action of the current is to draw it within the coil. W is supported by the train of wheels only, and is so adjusted that it will descend freely when the gearing is free to move, and the whole adjustment is such that with an ordinary current the gearing clears G. If the current becomes too strong C is drawn into the coil, and the feeding mechanism arrested by G; if it is too weak the core descends and advances the upper carbon. The second part of this in-

1649



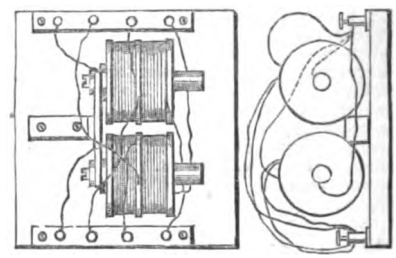


vention is in connection with incandescent lamps. It relates to the form of lamp connections, obtaining a vacuum, and the manufactnre of the carbons. The carbon B, Fig 2, is held by platinum supports, C C1, passing through the globe A at D D1 by tubes of glass sealed to the supports. The tubes are so made that capillary spaces are left just below the points of sealing to be filled with liquid insulating material. Fig. 2 shows the form of the lower portion of the lamp. S S are the capillary spaces, E is metal, F plaster of Paris to cement globe to bar E, G shellac or copal poured in when melted; H is a sub-base of insulating material with a metallic core containing a socket for screwing the lamp to its support. C is carried down to this metal base, C1 to the metal plug K, which is insulated from base E, and connected with wire S1. Before fixed to the base the globe is exhausted, then filled with a hydro-carbon gas, exhausted again, filled with the hydro-carbon again, and so on, as found necessary; then it is hermetically sealed and attached to base. The inventor claims that should there be a residue of hydro-carbon the carbon is deposited on the weakest part of B when rendered incandescent, and so helps to strengthen it. The lower part of the carbon is fixed to the platinum as shown in Figs. 3 and 4, so that there must be good contact. In Fig. 4, B is the carbon, M M soft carbon discs, K K platinum washers, T screw. Lastly the invention deals with the carbonisation of the raw material for carbon. A carboniser is used, in which the material is placed, heated over a gas stove for ten or twelve hours to expel aqueous vapour and air, then placed in a muffle furnace and raised to a white heat. During both periods of treatment the material is surrounded by a volatile hydro-carbon supplied from the carburetter. The inventor claims the various combination of mechanism, springs, &c., and the telescopic apparatus in the clock-work lamp, the hydro-carbon vacuum, the combination of globe, platinum connections, capillary spaces, base, sub-base, and ring, the combination to obtain good contact between the carbon and platinum, and the process of carbonisation in presence of hydro-carbon gas.

1585. Improvements in Coils for Electro-Magnets and Other Purposes, *G. George Scarlett.—Dated 17th April,* 1880. 6*d.*

The inventor winds two or more coils or helices of wire round the same core, or compound helices, each division of the coil being of the same resistance as the line in telegraph, or as the producer of electricity in electro-magnets. The figure

1585

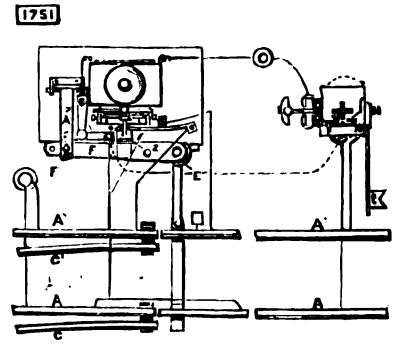


shows a horseshoe magnet wound with eight independent wires. The inventor claims (1) the several independent insulated wire winding, and (2) the compound coils.

1751. Improvements in Electric Signal Apparatus for Railroads, *W. Morgan-Brown.—(A communication.)—Dated 29th April,* 1880. 1*s.*

This invention relates to the employment of automatic signals on railways, and consists of a number of combinations of apparatus, electrical and mechanical. The drawing shows a section of the line, the signal apparatus at the right hand, the locking gear at the left. A A1 represents main line, B B1 the switch rails, C C1 the swing rails. The switch rails are held in a shoe connected with the shaft E, which shaft has an attaching lever, F. At the end of F is a perforated stud, which engages the arm A2 when the switch is in place as in the Fig., the locking pin being inserted in the hole, keeping A2 down, and depressing the spring. The arm A2 is worked by

1751



hand and suitably mounted. From F is an arm, C2, so shaped as to engage a switch-locking device, operated by an armature attracted by an electro-magnet made operative from the signal station. When the armature is attracted it lifts a catch and leaves C2 free to be drawn out laterally. The under front face of the catch is bevelled, so that the catch, when not actuated by the armature, is free to act by gravity, engages the arm C2, and locks the switch lever F. In connection with the locking apparatus is also a signal apparatus worked electrically. The inventor makes no less than twenty claims.

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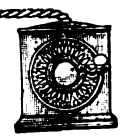
Submarine Telegraph Company	Lady Carmichael	—	—	—	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.
Great Northern Company	ss Store Nordiske	832	120	—	—
International Ocean Telegraph Company of America	tw sc Prof. Morse	900	—	—	Key West, U.S.
West India Telegraph Company	Duch. of Marlboro'	402	—	—	—

ZANNI



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SLIP

JAMAICA.—A circuit telegraph round the island is expected to be completed this month.

BRITISH COLUMBIA.—New Westminster is in future to be the head-quarters of the British Columbia telegraphs.

SWITZERLAND.—We learn that the Swiss Telegraph Administration have adopted Theiler's transmitter for use in the telephone exchanges now starting in that country.

MELBOURNE.—The first Social Congress in Australia was opened on Oct. 9. On Oct. 14 a *conversazione* was held in the Exhibition, which was illuminated by the electric light.

THE SS. "EDINBURGH."—This vessel, lately used by the Telegraph Construction and Maintenance Company as a cable ship, has been sold, and is intended to be used as a cattle ship.

ELECTRIC LIGHT AT HAVRE.—La place Louis XVI., le Jardin Public, and la place de la Sous-Préfecture are about to be lighted by the Jablochkoff system.—*La Lumière Electrique.*

NAVIGATION BY ELECTRIC LIGHT.—We understand that important trials have been made lately on the Rhine in order that navigation may be carried on at night by means of the electric light.

ISLE OF WIGHT CABLE.—For several days past the Isle of Wight has been shut off from telegraph communication with the mainland, owing to the parting of the cable between Ryde and Portsmouth.

RIFLE MARKING.—The *Morning Advertiser* suggests the use of butts that register hits electrically. Visitors to the International Exhibition at Paris will remember such a "butt" in the electrical department.

CABLE LAYING AND THE ELECTRIC LIGHT.—During the recent operation of laying the Marseilles and Algeria cable the after part of the ship was lighted each evening by means of two Serrin lamps and a Gramme machine.

THE BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The Directors have declared an interim dividend of 2s. 6d. per share, or 5 per cent. per annum, free of income tax, for the quarter ended 30th September last, and payable on the 24th instant.

WEST INDIAN CABLES.—Communication is re-established between St. Thomas and Porto Rico; but both the cables from St. Croix to Porto Rico and to St. Thomas are still interrupted, as is also the cable between Guadeloupe and Antigua.

THE ANGLO-AMERICAN COMPANY'S CABLE.—We understand that the Telegraph Construction and Maintenance Company's ss. "Scotia" has buoyed the Brest end of the faulty cable, and, weather permitting, we may soon hear of the complete repair of the cable.

HOLIDAYS FOR TELEGRAPH OPERATORS.—Clerks in the service of the Western Union Telegraph Company appear to be well off for holidays. On the 25th November, and also on New Year's Day, as well as on Christmas Day, the office hours, except at large stations, are from 8 to 10 a.m. and 4 to 6 p.m.

THE ELECTRIC LIGHT IN BRISTOL.—At the meeting of the Bristol Sanitary Authority last week, it was resolved not to accept the price offered by the gas company for lighting the city, and the committee resolved to authorise the expenditure of £500 in an experiment for lighting the city by the electric light.

FIRE OCCASIONED BY ELECTRIC LIGHT.—*La Lumière Electrique* reports that a fire broke out in the Lafayette Theatre, at Rouen, the other evening, in consequence of some negligence in the management of one of its electric lamps. Since this accident the lamps have been enclosed in wire cages, similar to those protecting gas.

THE CUBA SUBMARINE TELEGRAPH COMPANY.—The number of messages passing over this company's lines during the month of November last was 1,906, estimated to produce £1,900, against 2,772 messages, producing £3,110 in the corresponding month of last year. The traffic receipts for the month of September last, estimated at £1,800, realised £1,713.

PARIS.—At a recent meeting of the promoters of the Electrical Exhibition to be held next year at Paris, at the Ministry of Posts and Telegraphs, under the presidency of M. Cochery, it was stated by M. Berger, the head commissioner of the Exhibition, that the voluntary subscriptions already exceeded the 500,000f. demanded by the State as a guarantee fund.

MARRIAGE BY TELEGRAPH.—The United States *Law Journal* warns people against the growing custom of getting married by telegraph. That the warning is seriously meant is proved by a statement in a recent number of the *Journal of the Telegraph*, from which it appears that "several of such marriages have already taken place, and unless the practice is checked many more will be likely to follow."

ROUND-ABOUT.—It is amusing to notice the straits that some papers are put to for information. We, as our readers are aware, gave a long abstract of Mr. Swan's paper on "Electric Light," read at Newcastle. The American papers commented on the information then given, and now some English papers have just woke up to the fact that Mr. Swan has done something, obtaining their information from American sources, but *without acknowledgment.*

MR. SWAN'S PATENT.—The mystery of Mr. Swan's carbons is, we are told, at length disclosed. They are made of vegetable parchment—commonly called parchment paper—cut into strips and carbonised; they are then bent to the required shape and fixed inside the exhausted globes in the manner publicly described by Mr. Swan. The so-called vegetable parchment is paper prepared with sulphuric acid, whereby it becomes exceedingly tough and compact.

THROWING STONES AT INSULATORS.—At the Nuneaton Petty Sessions four little boys were charged with damaging the insulators used in connection with the telegraph wires belonging to the London and North-Western Railway. No less than seventeen insulators had been broken. Messages were delayed in consequence, and it was found almost impossible to work the block system. The lads, who were truants from school, were each sentenced to receive six strokes with a birch rod.

THE EDISON COMPANY.—It is stated that the company which owns Edison's light patent is worth 900 per cent. premium, and no shares for sale. Real estate has been quietly purchased in New York, and soon it is hoped that the light will be in practical competition with gas. We know not the exact value of these rumours, but have some reason to expect that the assiduous work given by Edison and his assistants to the electric light for months past will bear real fruit.

THE MAGNET IN MEDICINE.—An article in the *Scientific American* of Dec. 4, after referring to historic investigations, concludes by stating that Dr. Hammond, late U. S. Surgeon

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General, has been trying the effect of magnets in his practice for a couple of years or so, and is convinced that the magnet is really capable of exercising a strong physiological influence, and that there are substantial reasons for believing that it may be used to advantage in medicine. He has tried it in cases of neuralgia, chorea, and paralysis, sometimes with strong evidence of beneficial effects.

Gordon's Electric Lamp.—We believe we are correct in stating that no authentic description of this lamp has yet been given for publication. A contemporary in its haste to describe the lamp simply rushed to the Patent Office, and abstracted a patent specification, without, however, hinting in the article how its information was obtained. A second patent, we may say, has been applied for, and the inventor may find it necessary to apply for a third. The abstracted specification will duly appear in another column, and as soon as details can be made public we shall describe and illustrate the completed invention, which will probably include a generator as well as a lamp.

Good for Gas-shareholders.—Mr. G. E. Davis, F.C.S.' in a paper read before the Manchester Scientific and Mechanical Society last week on the "Utilisation of Residual Gas Products," spoke strongly in favour of electricity as an illuminating agent, and contended that the objections which had been raised by the opponents of electricity, namely, first, its cost per unit of illuminating power; second, the deep shadows it produced; third, its tendency to pop out suddenly; and fourth, the production of nitrous vapours by its action, possessed no weight. Mr. Davis thought there would be far more profit from gas distilling if conducted and considered as a purely chemical operation, and solely for other products, not gas.

Electric Light at Seaside Watering Places.—An official connected with the Corporation of Blackpool writes that, while reading with pleasure in the *Daily Telegraph* the step about to be taken at Brighton to prove the practicability of the electric light for street lighting, the important Lancashire watering place, Blackpool, is the town in which the electric light was first used on any complete scale for public lighting, and that in the two past seasons (1879 and 1880) the parade and the seaward ends of the two piers, have been in this way successfully illuminated, the lamps—nine in number—being placed at a height of sixty feet, and each lamp having an illuminating power of 6,000 candles. The effect at night near the sea is delightful.

Electric Light and Fog.—A contemporary, describing the late fogs in London, makes the following curious observations, which, if true, point, we think, to the desirability of correcting the colour of the electric light by means of suitably tinted globes :—"Last night's fog was a somewhat uncommon tone of grey. If it was one of the blankets of the dark, it was a blanket not yet washed, and with no yellow shade as yet brought out in it. Perhaps it was the peculiar nature of its tint which made it especially detrimental to the electric light. Along the Embankment the orange specks of gas made themselves somehow apparent, faintly beaming through the dimness; but the pale silver grey of the fog seemed to assimilate the sheen of the electric light and absorb it."

Cost of Telegraph Messages.—The Supreme Government of India have declined, for the present, to reduce the cost of inland telegraph messages. The proposed reform is strongly supported by H.E. Sir James Fergusson, as well as by the Chambers of Commerce at Calcutta and Bombay. A rupee is charged for every six words, and, looking at the expense of establishing and maintaining telegraphs in India, Government say they are not prepared to adopt any revision of the tariff, the effect of which would be to burden the general revenues in order that the senders of telegrams might be enabled to transmit them at a lower rate than the cost price. When, however, there is a surplus revenue, Government promise to reconsider any proposals for reduction that may be put forward.

A Large Holtz Electrical Machine.—Messrs. J. and H. Berge, of New York, have just completed a very large and finely-constructed double plate Holtz electrical machine. This, says the *Scientific American*, is probably the largest Holtz machine ever made, the revolving plates being forty-five inches in diameter, and other parts in proportion. By means of a continuous charging apparatus attached to the machine the inductors may be readily charged without recourse to the catskin and rubber plate. The machine, together with the charging apparatus, is mounted on a massive mahogany table, which is sufficiently large to support any apparatus used in experiments. By an ingenious arrangement of mechanism the crank which rotates the large plates is made to turn the charging apparatus. This machine is capable of yielding a 26-inch spark. By way of contrast, this firm exhibit a diminutive Holtz machine having a 5-inch revolving plate, and yielding a 1-inch spark.

The Electric Light on Board Steamships.—An experiment is about to be tried by the Great Eastern Railway Company on board one, at least, of their continental steamers, by using the electric light for the purpose of river navigation. The apparatus was fixed on board the steamer Avalon, but no trial has as yet been made. There can be no question that, to an extent, it will prove of great assistance on the Dutch, Belgian, and English coasts, especially during the winter months, but it is doubted how far it will be successful as regards the lights exhibited by other vessels. The service it will render in distinguishing the course to be steered by the steamer will be valuable enough, the only point open to question being as to the influence it will exercise over the side lights—red and green—of vessels travelling in the fairway of the steamers, so as to avoid the danger of collision through mistaken ideas as to the "rule of the road." One of two things will probably happen—either the steamer's side lights will be obscured by the power of the electric light which she carries, or, the electric light will have the effect of neutralising the colours of the side lights carried by the approaching vessel.—*East Anglian Daily Times.*

Hull.—A meeting of the Lighting Committee of the Hull Corporation was held on the 26th ult. "to approve and put into operation the Electric Lighting Bill obtained by the Corporation in the last Session of Parliament." The borough engineer submitted plans providing for six 6,000 candle-light-power lights, one 2,000, five 400 for street lighting, and also one of 2,000 candle-power, and two of 400 for the Town Hall. The proposed electric lights would supersede the lighting power of 105 gas-lamps of 16 candle-power. Messrs. Siemens Brothers estimated the cost of the requisite plant for the extent of the electric lighting described, including steam engines and boilers, dynamo-machines, leading-wires, masts, brackets, lamps, lanterns, and insulators, at £3,700, in addition to which the engine-house and site would cost, say £1,300, making the total first cost £5,000, and they estimated the annual maintenance of the street lamps at £672, and the carbons for the Town Hall lights at 5½d. per hour for every hour the whole are lighted. With respect to the street lighting, therefore, the sum of £672 per annum, plus the first cost of plant, would

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produce lights equal to 40,000 candle-power as compared with 1,680 candle-power for the 105 gas-lamps to be displaced, and costing £420 per annum, whilst the same apparatus would also provide lights for the entrance hall, reception room, and council chamber in the Town Hall. It was resolved to take steps to make trial of the electric light for twelve months.

Thermo-electric Power of Iron and Platinum in Vacuo.—Professor C. A. Young, of Princetown, N.J., describes, in the November number of the *American Journal of Science*, an experiment on this question. It is stated that Exner a few months ago published a paper, asserting that the thermo-electric power of antimony and bismuth is destroyed by removing them from all contact with oxygen and immersing them in an atmosphere of pure nitrogen. From this he argues that the thermo-electric force in general is due to the contact of the gases which bathe the metals. The following experiment was tried to test the theory:—By the kindness of Mr. Edison and Mr. Upton a vacuum tube was prepared in Mr. Edison's laboratory, containing an iron wire about two inches long, firmly joined to two platinum terminals, which passed through the walls of the tube. The tube was exhausted until the spark from a two-inch induction coil would not pass $\frac{1}{8}$ of an inch in the gauge-tube, indicating a residual atmosphere of about one millionth. The wire was heated to incandescence during the exhaustion, in order to drive off any possible occluded gases. The platinum wires outside the tubes were joined to iron wires, the joinings being covered by glass tubes slipped over them, and a sensitive reflecting galvanometer was included in the circuit. By laying the tube and connected joinings in the sunshine, and alternately shading one or several of the joinings, it was found that the electromotive power of the joinings within the tube was precisely the same as that of those without, and the development of current just as rapid. There was no trace of any modification due to the exhaustion.

Legislation.—It is highly amusing to read the utterances of gas managers, but it is difficult to understand the crass ignorance shown by them on the subject of electric lighting. One would have thought the "signs of the times" pointed clearly to the extensive use of electricity, but the gas managers do not and will not see the "finger on the wall." On the 27th of November the President of the Manchester District Institution of Gas Engineers gave his Presidential Address, in which he remarked, "There were some of them who had had greater opportunities than others of testing the electric light, and to these they had been able to look for some information as to what was to be done by the light which was to effect such a revolution in the world of lighting. All this had now passed away. The electric light had been, and he had almost said it had gone; but, at all events, it had almost gone back to that quiet position from which it emerged three years ago. It was not more applicable now to ordinary lighting than it was then, and although they all admitted that there was for the electric light a sphere of usefulness which it would be able to occupy, it did not seem at all likely to enter into general competition with gas." The electric light has gone back to that quiet position it held three years ago! Well, Mr. President, we only ask you to reconcile this "going back" with the facts that the following places are seeking to promote private bills during the forthcoming session for electric light purposes:—Alnwick, Barrow-in-Furness, Birkenhead, Hexham, Irvine Burgh, Lincoln, Salford, and Stalybridge. Did gas at its introduction make any greater progress than the electric light has done, and is doing?

City and Guilds of London Institute.—We have before us "The Report to the Governors" and "The Programme for 1881." At the present time we wish only to direct attention to pages 23 and 24 of the Appendix to the programme, which contain the questions on "Telegraphy" set at the last examination by the examiner, Mr. W. H. Preece. With the general plan of these questions we have no fault to find—they seem to have been drawn up with a sufficiently wide and safe margin to enable the examiner really to test the merits of the students, but we would suggest, with due deference to the powers that work these things, whether still greater perfection in the stating of the questions cannot be attained. Take only one, and that the first. "Define electromotive force and resistance?" Surely the answer to this gives little or no idea of the knowledge held in the writer's brains. What is wanted, we conceive, is to know the writer's own ideas as to electromotive force and resistance. Has he or she any ideas, or have they simply depended on books, books, books? Would full marks be obtained by writing $C = \frac{E}{R}$ in reply to the question, What is Ohm's law? And yet $C = \frac{E}{R}$ might be given as *an* answer, and a tolerably correct one, too. A little alteration in the wording of such questions would satisfy our desires. The examiner, however, may have other objects in view in setting such questions, and may be perfectly justified in putting them. Does the student obtain an accurate idea of what he reads? Let us test by such and such a question. We might for this prefer another kind of question to test such a point, than these so admirably suited to test grasp of the subject.

Multiplication of Telegraph Wires in Towns.—At a meeting of the Edinburgh Town Council on Nov. 30, Bailie Anderson moved—"That it be remitted to the Lord Provost's Committee, with powers, to order the removal of such telephone wires throughout the city as endanger or inconvenience the public, and to take steps to prevent the future erection of such wires without authority." He stated that it was out of no spirit of opposition to the extension of these useful instruments that he brought up this matter, but when they saw wires stretching in all directions for the use of a private company, without any authority or control whatever, it was time to look into the matter. Across St. Andrew-square there were no less than thirty wires, and there was no doubt they sometimes fell, for he had seen two himself that had been broken by the wind. What he wanted was that the wires should be erected in such a way as to be of the least possible danger to the community, and as little offensive to the eye as may be, and that they should not be allowed to make connections to houses without consulting the proprietors, as he knew had been done. Mr. Clark, who seconded the motion, said that the other morning he found men on the top of his roof conducting a telephone wire across without the slightest authority whatever. Mr. John Boyd remarked that there was a good deal of anxiety on the part of the public with regard to the wires, and he thought there was some cause for it. He proposed some alteration on the terms of the motion. On the suggestion of the Lord Provost, the motion was altered so as to read "consider and report on such telephone wires," &c., and to report generally on the subject. Mr. Gibson said it had been an instruction to him at his ward meeting that all private companies using public property should be made to pay for their privilege, and he thought the principle should apply in this case. The motion was then passed.

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LESSONS FOR LEARNERS.

(CONTINUED FROM PAGE 28.)

We must, however, be careful not to rush too quickly to a conclusion, and so, just to see if the same thing continues, I will put in longer and longer wires, though each is of the same sectional area as its fellow. You see with this one the needle does not swing so far, and with this one still less arc is traversed. I said that the needle moved in accordance with the quantity of current passing through the galvanometer in a given time. You see then that the longer the wire is the less is the current passing through the galvanometer.

Suppose, for an instant, that you have an ordinary locomotive engine, steam up, plenty of fuel and water, and further suppose that whatever else you do the steam remains at the same pressure. Now put one carriage behind the engine, and open the valves. There goes your iron horse. But put another, and another, and another carriage on, and in this way you will soon find the engine will move its load more and more slowly. Each carriage offers a certain resistance to motion, so that you have only to put on enough carriages and the powerful engine is unable to move the load. The engine exerts force, the carriages offer resistance. Now, this battery is somewhat like the steam engine, and the wire is something like the carriages. Putting in longer and longer wire in the one case is similar to putting on more and more carriages in the other case. You have, so to speak, something here exciting force, and something here opposing the force that is offering resistance to its action. Thus we come to talk of a wire having *resistance* to the electric current.

It will be best for us at present to think of the electric current as a something passing along the wire like water passes along a pipe. When I took the wire of large area there was more room for the passage of the current, and so more passed along, just as if, with plenty of water, and the height of the top of the water in the reservoir remaining the same, I had increased the size of the pipe through which it flowed; then more water would have passed by any one point in the pipe in a given time, in accordance with an easily ascertained law.

Experiments carefully conducted have shown that *whenever the resistance* of the material through which the electric current has to flow *is doubled, the current* flowing *is halved*, if the resistance is trebled, the current is reduced to one third, and so on. Mathematicians thus speak of this, "that the current varies inversely as the resistance." I may just whisper to you, though of course you all know Latin better than I do—that "varies inversely" means "changes in the other way," so if one increases the other decreases. You see the clever mathematicians who first wrote out these things thought everybody as clever as themselves.

We have now to consider the effect of change of material upon the current. This will not detain us long. I have here, similar in sectional area and length, some wires of silver, copper, platinum, iron, and lead. You see the deflection of the needle when the silver wire is connected, and on trying the copper wire we see very little difference, but now we try the platinum, and the swing of the needle is far less, and with the iron the needle does not get so far as with the platinum, whilst the lead wire gives the worst result of all. You see, then, that different materials resist the passage of the current in different degrees. Professor Matthieson, who tried a great many experiments to see the effect of different materials, has given us the following table, where the best conductors are put at the top, gradually getting worse as we go lower down:—

Silver	Acids	Silk
Copper	Saline Solutions	Glass
Gold	Sea Water	Sealing Wax
Zinc	Rarefied Air	Sulphur
Platinum	Melting Ice	Resin
Iron	Pure Water	Gutta Percha
Tin	Dry Ice	India Rubber
Lead	Dry Wood	Shellac
Mercury	Porcelain	Paraffin
The other metals	Dry Paper	Ebonite
Carbon	Wool	Dry Air

I have just used the term "conductor." When any substance allows the passage of the current it is called a "conductor;" if the current is unable to pass, or with very great difficulty and under exceptional conditions, the substance is termed a non-conductor or an insulator.

Let us return to our steam engine and battery. You all know that the power of a steam engine is said to be so many horse-power, and that while the steam pressure is unaltered the power remains constant. We do not talk of the horse-power of our battery, but we talk of its electromotive force. Whether the term be good or bad we will not for the present trouble ourselves. The electromotive force (E.M.F.) of the battery will for the time being be supposed to be like the power of an engine with the steam at a constant pressure—constant.

We have spoken of "current," of "resistance," and of "electromotive force," and we have seen that somehow they are dependent the one upon the other. The current and resistance are of an inverse nature, but if we think a moment we shall understand that this "inverse law" does not hold good with E.M.F. and current. Two engines do double the work of one. Let us try two batteries. I have a piece of wire in the mercury all ready as before with one battery. You see the needle swing; mark well where it stops. Now let us put on another battery, but first take the end of the wire out of the mercury. All being ready, I put the end of the wire in again, and lo! the needle flies past its late position, and remains past. Careful experiment and a little mathematical knowledge would show us that the battery is like the engine. Two are twice as effective as one, and so on. Our friends the "law"-finders would say that "the current varies directly as the E.M.F." I may write all this:—

"Current varies directly as E. M. F., and inversely as resistance," or $C \propto \frac{E}{R}$, so frequently written $C = \frac{E}{R}$. This law is called "Ohm's law."

What is the use of it? What did I trouble about such dry stuff in an early lesson for? Do you remember reading an account of Mr. Swan's electric lamp in a paper called *The Electrician*, and asking me what he meant when he spoke of Faraday saying that the same current that would heat one inch of platinum wire white hot would heat an infinite length of wire white hot? I did not tell you then, but I think I can make you understand now.

Look well at the formula $C = \frac{E}{R}$.

You all understand vulgar fractions, and you can see that $\frac{E}{R}$ is a fraction. You also know that if I multiply both the numerator and the denominator of a fraction by the same number the value of the fraction is unaltered. Recollect the value of the fraction in this case is C. Suppose, however, we use figures. Write $2 = \frac{4}{8}$.

Now, if I multiply 4 and 8 by the same number, 2, or 3, or 4, and so on, I get

$$2 = \frac{8}{16}, \text{ or } 2 = \frac{12}{24}, \text{ or } 2 = \frac{16}{32}, \text{ and so on.}$$

The figures of the fraction are altered, but the value of the fraction remains the same. So

$$C = \frac{2E}{2R}, \text{ or } C = \frac{3E}{3R}, \text{ or } C = \frac{nE}{nR},$$

and Faraday's statement can be read like this: If one inch of wire giving a certain resistance can be heated white hot with a certain battery giving a certain current, and you increase the length of that wire, and therefore the resistance, you must increase your battery power proportionally to the resistance if the current is to remain the same as before.

(END OF LESSON I.)

THE EXCHANGE TELEGRAPH COMPANY.

We have lately been favoured, through the courtesy of Captain Davies, the managing director, with an inspection of this company's premises and apparatus. The electrical and mechanical arrangements, which are under the control and management of Mr. F. Higgins, electrician to the company, were shown to us by that gentleman and display an amount of mechanical skill in their organisation which does the greatest credit to the inventors as well as to Mr. Higgins, who has greatly improved on the original instruments, actually doubling their speed. The company, which was founded in 1872, purchased the patents of Messrs. Calahan and Edison from certain American gentlemen who held the English patents, the instruments having been in use for some years in America. The company's principal business is to supply stock exchange, bank and financial news, movements of bullion, &c., to their subscribers, at each of whose office is fitted an instrument which prints off in roman type the news and prices to all simultaneously on tape paper. The instruments require no winding and no local battery at the receiving end. Two wires are necessary, one circuit starting and driving the type wheels, and the other actuating the parts that cause the printing of the letters.

The sending instrument is a keyboard like a pianoforte keyboard. A notched wheel is revolved by a clutch driven by an electro-motor worked by six bichromate elements. This notched

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wheel has 15 notches, the space between the notches as the wheel revolves makes contact in a local circuit containing all the relays of the various circuits, each circuit containing several instruments. The relays being thus moved causes a current along the wire which works the type wheel, and thus causing the type wheel to advance. The pressing of a key causes the notched wheel to be stopped, and at the same time sends a current by means of relays along the printing wire of each circuit, printing the letter corresponding to the key pressed. The instrument is partly described with diagrams in a paper by Mr. Higgins, read before the Society of Telegraph Engineers in March, 1877, and is published in the *Journal* of the society. But the notched wheel in the sending instrument was at that time driven by clockwork and weights, whereas it is now driven by an electro-motor. It would be impossible to give an intelligible description of the instruments without numerous drawings and diagrams. In the instrument room at the central station in Cornhill the news is received from the Stock Exchange, the Post Office, and other centres of news, on ordinary Morse instruments, and then the printing instrument is worked to distribute it. All the relays are in a separate room, where also are the terminal boards and lightning protectors. There are two central offices, one at the head offices, 17 and 18, Cornhill, and the other at 8, Piccadilly. From these radiate forty circuits from Cornhill, and twenty from Piccadilly, and the two offices are joined by five wires. On each circuit there are several instruments, situated at the subscribers' offices, who consist of stockbrokers, merchants, and bankers. From the Piccadilly office M'Mahon's Telegraphic News Company send sporting, parliamentary, and general intelligence to their subscribers. The Exchange Company work under licence from the Post Office, being bound not to carry their circuits more than one mile from each of their two stations. The lines used consist of about fifty miles of underground wires rented from the Post Office and seventy miles of overhead wires belonging to the company. Some of these overhead wires consist of copper wire stretched from insulators, and others of copper wires insulated and formed into cables suspended from iron wires, which, it may be a comfort to the public to know, are regularly renewed at stated intervals, without waiting for them to rust through. The battery room at Cornhill, situated at the top of the building, contains 760 of Higgins's patent bichromate batteries, and that at Piccadilly 320 elements. The local battery working the forty relays at Cornhill consists of 20 elements, and the line circuits batteries vary from 12 to 90. In Mr. Higgins's battery the graphite plate, 4in. by 6½in. by ¼in. thick, is plunged into hot paraffin for a certain distance, and after the paraffin has cooled the plate is cut out. Thus the paraffin remains in and on the plate better than by the ordinary plan of dipping. The contact is made by simply scratching the surface and clamping copper wire to the plate by a bolt and nut passing through the plate. In other forms of the bichromate battery great trouble was caused by the contact between the connections and the graphite plate failing and causing enormous resistance, in fact at times almost a perfect want of continuity.

The solution in the cells is in the proportion of 5lb. of bichromate dissolved in 45lb. of water; this great quantity of bichromate, in proportion to the water, being brought into solution by a peculiar slow method of adding the sulphuric acid. The resistance of one of these Higgins elements is only one-third of an ohm. The premises contain an instrument maker's shop, at the top of the building, and the company not only repair but make their own instruments.

Mr. Higgins informed us that with these 760 elements, each having an electromotive force of more than two Daniell's, an arc 10 or 12 inches long can be obtained, which rises in an arch and then bursts.

The Exchange Company have also a system of fire calls, which is rented and worked by the Metropolitan Fire Brigade. Posts in the street contain an arrangement of wheelwork by which, when a handle is pulled, a small ivory disc, with notches in it, revolves and interrupts the circuit in certain groups of intervals, thus sending to the central station, where a current is constantly kept on line through the receiving instrument, the number of the station calling. Thus, 334 would be three dots, space, three dots, space, and, lastly, four dots. The first interruption of the circuit starts a trembleur bell, which rings till stopped by the attendant. The disc revolves three times for every pull of the handle, and thus the signal is sent three times, so that should even a dot be missed in one signal it is unlikely to be missed in each. The signals are given on a Morse in dots on the paper. A reply is given by a small shutter appearing, with the words "signal received" on it. The whole of the mechanism is fitted to the front face, which turns on a hinge at its base, and when turned down is kept horizontal by a chain. This makes a very convenient arrangement for inspection, and is an important point often lost sight of in telegraphic apparatus. The company have these pillars for fire calls extending from Islington to the Elephant and Castle. Where possible, the circuits are complete metallic circuits, so that want of insulation at one spot would not disturb the working. The Exchange Company have also a system called the "call system," by which subscribers can ask the central station to send them messengers and cabs, &c., or give warning of fire.

The exchange system is largely used now, by stockbrokers principally, and will no doubt continue to extend; but it is curious that the system and custom of doing business amongst brokers in Manchester, Liverpool, and Glasgow, though differing in each town, is such that the exchange system is still only of use in London as regards brokers' work. That it would be of use in distributing general intelligence when received at the principal post offices to the various newspaper offices and Press Association rooms, &c., instead of sending out that wretched stuff known as "flimsy," thus saving the time of messengers, seems highly probable, even if the speed is not quite equal to the Wheatstone Automatic, by which news is generally received at the Post Office.

From what we have seen of the whole arrangements it appears to us, if we may express an humble opinion, that the system has been very creditably worked out and managed, and does great credit to Captain Davies, the managing director, and to Mr. Higgins, the electrician.

LITERATURE.

Beschreibung der Neuen Feuertelegraphen-aulage in Stuttgart Von W. E. Fein.

In the whole history of the electric telegraph there is probably nothing more surprising than the slowness with which it has in this country, and on the Continent generally, indeed, been specially applied to the announcement of fires. Its application to this purpose seems to have been initiated by America, and there certainly carried to a high degree of perfection. This remissness is the more unaccountable as, apart from the obvious advantage, theoretically, of using such means, the logic of facts is overwhelming in favour of such a course.

Two years ago the municipal authorities of Stuttgart awoke to the desirability of having a system of fire telegraphs, and placed the work in the hands of a local firm of electrical instrument makers, Messrs. Fein, who have just published a clear and well-illustrated little book, describing how they carried out the undertaking.

The telegraph system at Stuttgart is worked on the radial—not the circle or loop line plan—that is to say, the Automatic Fire Annunciators, as they are called (we should have preferred indicator), the speaking Morse and telephone stations (Messrs. Fein having adopted telephones in some instances) all radiate from the central station, with which they are in circuit.

The Stuttgart automatic fire annunciators are worked upon the ordinary principle of a permanent current from the central office, broken by pulling the little knob, and thus allowing the contact wheel to rotate. The periphery of this wheel is so shaped that it breaks the current in such a way as to form, *ipso-facto*, a certain letter of the Morse alphabet, which signal is produced, of course, on the instrument at the central station. This signal is varied in such a manner that each point has its own special one, and this indicates the position near which the fire has broken out. Instead of having the key of the automatic fire indicator kept by the police or at the house nearest to it, Messrs. Fein advocate the plan of lightly soldering it to the box itself, from which it can easily be broken off and used when necessary, by which means much invaluable time may be saved—the policeman, even in Germany, not being always at hand when wanted—which applies also to unofficial persons, who are likewise liable to mislay keys as well as other important things.

The Palace and Royal Theatre are included in the 75 points from which fires may be indicated, as well as the towers of 2 churches, the Stuttgart municipal authorities taking a very different view to that of a High Church vicar in a suburb of London, who a few years ago refused to allow the fire escape to be kept against the parish church, which he considered it would desecrate. By an ingenious arrangement of Messrs. Fein's the watchman at each church tower must make the circuit of the tower before he can give the signal to the central office, which is done every night at certain fixed times, showing that he is attending to his duty. In view of the enormous reduction of serious fires effected by the use of a good telegraph fire system—4 per cent. as against 29 per cent. formerly—it is to be hoped that in this country we shall more generally avail ourselves of such valuable aid in overcoming one of our most dangerous enemies to life and property.

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PATENTS AND PUBLICITY.

Some amusement was created the other evening at the Society of Telegraph Engineers by the remark that "the object of a patent is publicity." The members who heard it evidently thought this a good joke; but if any of them have since given the subject a little reflection they will have seen by this time that there was quite as much truth as irony in the statement. If publicity is not the aim of a patent, publicity is usually the result; and this is probably what Mr. Swan meant when he disposed of his interrogators with the remark we have just quoted. He was evidently embarrassed by the questions put to him as to the make and material of the wondrous little carbon filament enclosed in his lamps; and, confronting a scientific audience, presumably in no way bent upon appropriating his property, the weight of secrecy laid heavily upon him. But his patent was not yet fully secured; so, casting about him for an excuse which would serve him also as an answer, he relieved himself by saying, in effect, this—I am anxious to tell you, and I fully intend you should know all about it, in proof of which I have taken out a patent which, as you know, will insure publicity. No one who had the pleasure of hearing Mr. Swan's ingenuous exposition of his invention and its history will doubt the sincerity of his plea; but for all that, without any disrespect to him, it may reasonably be doubted whether he would have been more communicative had there been no such things as patents in existence. Possibly this might have been in the minds of a few of the people who laughed; but to most of them, probably, the thought was uppermost that the material object of a patent is monopoly, and that it does not much signify what may be the name with which we please to dignify it. In other words, to the common understanding, a patent might just as well be secret as public for all the good anybody gets by its disclosure. The use of it is the thing they want, and this could be had as well without as with the secret of its make. To say, therefore, to the public that a present is made them of a valueless secret in return for a valuable monopoly is somewhat tantalising, not to say misleading.

This, of course, is the popular and superficial view of the virtues of a patent. As a matter of fact, the public do gain by publicity, and the patentee loses, or at any rate runs the risk of losing, something. To make known how you have got over a certain difficulty is an invitation to somebody else to get over it in another way. This other way can be patented, and though it may be no better than its predecessor, it competes in the same market, lowers the price to the consumer, and reduces the profit of the inventor. This is peculiarly hard upon inventors like Mr. Swan, whose device, if we are rightly informed as to its nature, will be fortunate indeed if it escape being "improved" by some ingenious manipulator of other peoples' ideas. Nor would absolute secrecy be any protection; even if impenetrably guarded it may be successfully imitated, or independently discovered by a rival, who will probably patent it. Patent laws do, in fact, compel patents, and bring with them such advantages both to the patentees and the public as are supposed to be conferred by laws of that kind.

But it is not strictly true that a patent insures publicity. There are many instances of the contrary, and we suspect there would be many more if the inventors themselves felt sure about their own secret. Not to go beyond things familiar to us just now, the mystery of Psyche remains hidden to this day, although it was exhibited in public for years; and the patent, we believe, while setting forth with much particularity and plainness as many details as are necessary to secure the proprietors, succeeds in mystifying the reader as completely as does Dr. Lynn when he tells his bewildered audience exactly "how it is done." Again, the essential secret of one important element in a certain well-known telephone is not revealed in the patent relating to it, and the statement passes current that the proprietor himself does not know it. If this be so he is especially fortunate, for the maker's secret—if it is the maker's—is pretty sure to be kept.

Returning to the meeting referred to in our opening remarks, we could not help being struck by the contrast—often commented upon, but brought into singular prominence on that occasion—between scientists and inventors, between the scientific spirit and what we may call without disparagement the commercial spirit. This was conspicuously manifested in the incident which made a present of what was probably a valuable as well as novel suggestion to anybody who could make a marketable use of it. It is not improbable that the same generous spirit which prompted this suggestion denied its giver one of the highest achievements of modern discovery. Mr. Varley, as his recent depositions before the Court of Exchequer sufficiently prove, was within a hair's breadth of the telephone ten years ago. He left the subject, but unfortunately did not take his secrets with him. With the scientific mind and the practical mind working together harmoniously, as they are at present, it will be strange indeed if a complete solution of the electric lighting problem is not speedily forthcoming.

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CORRESPONDENCE.

VAN CHOATE'S NEW CABLE SCHEME.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In your issue of Oct. 23 you devote a leader to the criticism of certain propositions made, as to the working of submarine cables, by Mr. S. F. Van Choate. That article is, permit me to say, not characterised by the usual good judgment attending the statement of facts from the editorial sanctum; for the reason that only half the truth is given.

In the first place, perhaps I owe an apology for bringing myself into the question, but I feel that as one of the reporters on the performances of Mr. Van Choate's instruments, and as a frequent contributor to the columns of your journal, I should not allow erroneous opinions to pass current.

Your editorial speaks of two patents as to the division in length of long submarine cables, one by Macintosh, the other by FitzGerald, as interfering with Van Choate's claims in this subject. Unfortunately for these inventors, Van Choate's patents for the division of a cable (as far as division is alone concerned) antedate theirs; in fact, he, and neither of the others, ranks as the first inventor.

Even were this not the fact, Van Choate's more recent inventions are not affected by either of the patents in court. First, Macintosh distinctly refers to a local battery of sufficient constancy, enclosed in a proper manner, as being sunk into the ocean. A suitable battery, it is scarcely needed to tell your readers, has yet to be invented. Van Choate's relay needs no local battery *in situ*; his relay is altogether of another order to that indicated by Macintosh.

FitzGerald's scheme certainly employs a common feature with that of Van Choate's instrument, namely, an electro-magnet; but unless FitzGerald wants to raise a Page-patent dispute in England such as has disgraced this country, I fear his claim would be untenable. Further, FitzGerald and Van Choate's inventions are entirely dissimilar, because the action of the primary circuit in FitzGerald's scheme does not call upon any fresh source of power in the secondary circuit, as does Van Choate's, for which reason Van Choate's invention must consistently have greater power at disposal. Again, FitzGerald must lose in power on his secondary circuit by the amount or value of the coefficient of induction between his primary and secondary circuits. Now, for the weak currents used in telegraphy, and especially in submarine telegraphy (and with the large soft iron cores necessarily attending FitzGerald's plan, which cores can never even approximate saturation), this coefficient will be only a very small fraction of unity, reducing as multiplier the efficiency of such a system of signalling to very low limits. In Van Choate's system, on the contrary, the received signals may be considerably stronger than those sent.

But Van Choate's invention does not alone depend on submerged relay. It embraces a type-printing system, based, as regards its signals, on a very careful study of the phenomena of induction as indicated by Sir W. Thomson in his well-known investigations. It is sufficient for this letter to say that this system works perfectly on an artificial cable we have here; this cable is of 772 microfarads capacity, and of 4,000 ohms' resistance, with an insulation of about 2 megohms. So, under these conditions, we have every reason to believe that there is a great step made in these matters by an American inventor.

Your criticism as to the small attention given to submarine cable working by the many professors who have seen these instruments I am obliged to notice, because I thought that the claims advanced by so-called "cable-doctors," who, when a poor cable is broken down, tell its symptoms by some unwritten laws of sympathy, were long ago exploded. The phenomena of cable induction are well enough known to those who have a practical laboratory training, or are so easily perceived that it would be farcical on this ground to say that such men as Barker, Dolbear, and especially Trowbridge were incompetent judges because they had not served apprenticeship on board a cable vessel, or in a cable factory.

I do not consider myself at liberty to give unauthorised a more detailed answer to your criticisms, but I shall be pleased at an early date to place before your readers the particulars of this invention. It may be said that Mr. S. F. Van Choate is well known on this side the Atlantic as a telegraph engineer, who has constructed and successfully financed some of the longest lines on this Continent.

My former experience with those in this mundane sphere who make the construction of electric spheres (and cylinders) their business is not so glowing as to warrant that I should blindly tack my faith to any invention or inventor, but in this instance (as you have favoured me by excepting me from the roll of ignoramuses in submarine telegraphy) I have no fear in asserting my full belief in all that the talented and scrupulous investigators have said about Mr. Van Choate's system.—Yours, &c.,

PAGET HIGGS.

Offices of the American Cable Company of New York,
Boston, Nov. 10, 1880.

THE ELECTRIC LIGHT IN THE CITY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: From the remarks made in your issue of November 27 upon the above important subject by Mr. Crompton, it is of course to be expected that he will laud up the advantages of his own electric lamp.

Unlike Mr. Crompton, I am in no way connected with any electric light company, and therefore I may be considered unprejudiced.

I have witnessed the Brush light in America, and upon a recent visit to Glasgow took the opportunity of viewing the Crompton light at St. Enoch station.

From the favourable notices given in your publication from time to time, I was led to expect much; but great was my disappointment at the performance of this light. I refer to the disagreeable flicker which I have experienced in all *clockwork* lamps, and so long as this remains unremedied I am not surprised at the Brush light obtaining supremacy.

All who are acquainted with these two systems of electric lighting—unless financially interested—cannot but admit that the Brush light is the steadiest and most practicable.

Mr. Crompton holds out a challenge, but as I am not in possession of the details of his tender to the City Commission it is useless for me to comment upon this point; but it would have been much more satisfactory if these figures had been given in his letter.

I have only one regret, which is, that the Commission did not place the whole undertaking in the hands of the Anglo-American Company; for then, I think, the experiment would have been more successful, and they would have economised the enormous sum of nearly £4,000 on the present contracts.

Mr. Paget Higgs, through the medium of your columns, suitably remarks "that electric lighting is not yet understood so well by English as by American manufacturers," and I come to the conclusion that these remarks are judicious.—Yours, &c.,

Bowdon, Cheshire, Dec. 1, 1880. CHARLES LEVER.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Mr. Montgomery has addressed to you a letter from which it appears that he poses as the champion of the Brush system of electric lighting. Your readers will, perhaps, remember the gist of my letter to be that, either the power of the Brush light was over-estimated at 2,000, or that the Gramme light was under-estimated at 4,000 candles. I challenged the Brush Company to show that their light was as much as one-fourth the power of the Gramme light. Mr. Montgomery goes on to say that "the absurdity of my figures places them beyond the pale of argument." By this manœuvre he evades giving any data on which your readers could pass their own judgments. I will therefore attempt to supply a few data myself. During the recent exhibition at Glasgow, three of the exhibitors, the Brush Company, the Lontin Company, and myself lighted up a piece of ground adjoining the exhibition for a football match. I took this favourable opportunity of comparing the power of my lights with the Brush lights. In placing the staff to obtain equal shadows I was not content with my own judgment, but obtained the assistance and opinion of several engineers of position in Glasgow. These gentlemen will, I have no doubt, be able to testify that the staff was placed as fairly as could be done under the circumstances, and that the possibilities of error were very small.

Two of my lights were compared with the Brush lights to right and left of them, with the following results:—

—	Distance of staff from Brush light.	Distance of staff from Crompton light.	Ratio of lighting power.
Measurement most favourable to Brush light	7½ yards.	25½ yards.	12—1
Measurement most favourable to Crompton light...	5½ yards.	27½ yards.	25—1
Mean of all measurements.....	6 yards.	27 yards.	20—1

The Brush lights were in ground glass globes 18 feet from the ground. My lights were in clear glass lanterns 50 feet from the ground. It is part of my system to use large lights, and I hang

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them so high that the direct rays are not an annoyance to the eyes. The Brush lights are usually hung so low that they must be surrounded by ground glass or some other diffuser. If I understand Mr. Montgomery rightly he still upholds the statement that each of the 16 lights of a 16 light Brush system is of the power of 2,000 candles. It follows from the above ratios that my lights are from 24,000 to 50,000 candles each. Although I honestly confess that I should like to measure my candle power with such a foot rule, the fear that "the absurdity of such figures would place them beyond the pale," &c., &c., has hitherto deterred me. On the other hand, if, as I believe, 4,000 candles is a fair valuation for the A Gramme light, the consequences of dividing this figure by the ratios above given in order to arrive at the candle-power of the Brush light, would be too grave to be attempted by me. I must ask your readers to do the sum themselves.

One word as to the Glasgow trials. Mr. Cunliffe Owen's excuse for the withdrawal of the Brush system is a very old one, which being translated stands thus :—The conditions were not favourable, therefore the horse was scratched. Mr. Montgomery, however, proposes a new trial, over a new course laid down by himself. It would, I think, require a more persuasive style than Mr. Cunliffe Owen possesses to persuade the engineering world that a jury composed of such men as Sir Wm. Thomson, Dr. Wallace, Dr. Hopkinson, Mr. Bottomley, and Mr. Mortimer Evans was less anxious than was one of the competitors to make the trials complete and exhaustive. Be that as it may, I, for one, with great pleasure accept the challenge of the Brush Company, though my reminiscences of Glasgow make me smile a little at the fervour with which it is given, and raise in my mind a doubt whether this new born zeal for public competition will be sufficiently long-lived to bear practical fruit.—Yours, &c.,

R. E. CROMPTON.

Mansion House-buildings, E.C.,
December 7, 1880.

WHAT IS ELECTRICITY?

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Since you published my letter in your number of 13th November, three issues of *The Electrician* have appeared, and yet no reply has come from Mr. Gordon. To keep in view the necessity for a reply from him I shall briefly recapitulate some of the facts. From my having discovered in 1839 that an insulated coal-gas flame indicated with accuracy the direction in which a current of frictional electricity moved I was enabled then to publish "that *there is only one electric fluid*, and that when the electrifying machine is put in motion the rubber merely draws the electric fluid out of the ground and the prime conductor gives it out." Mr. Gordon, in his new book on electricity, adheres to the old fabulous notion that friction always produces two electricities, and that when positive electricity is being given out at the prime conductor of an electrifying machine negative electricity is produced on the cushions and passes from them to the ground. In Mr. Gordon's letter to you (Vol. V., page 283), he wrote, "Mr. Johnstone's experiments, however ingenious they are, are hardly conclusive." And regarding the insulated gas flame, he wrote, "I fail to see how this affects the question of the direction of the flow of electricity." In my letter of 9th November (Vol. V., page 307), I described with further practical details the manner of using the insulated gas flame so as to establish that the rubbers of the electrifying machine collect electricity from the ground and pass it through the machine to the prime conductor, thereby proving that there is only one electricity. I asked Mr. Gordon to repeat this experiment and let you know the result. The experiment is of so simple a nature that Mr. Gordon must possess in his laboratory the means of making the experiment, and it might be performed in a very few minutes. This raises the question, Why has Mr. Gordon delayed so long his reply? It cannot be that Mr. Gordon regards this subject as a trifling or unimportant one.

Until public writers and lecturers such as Mr. Gordon have had it impressed upon them that there is only one electricity, we will never be able to get men to unite in one line of thought in the effort to determine *What is electricity?* and from the want of this union of thought concerning the theory of electricity the progress of the science is greatly retarded. It is therefore to be hoped that Mr. Gordon will make the experiment and let you know the result.

Further, he is in honour bound to do so, because he alleged that my experiments were not conclusive. Has he found the one I have asked him to try not conclusive?—Yours, &c.,

JAMES JOHNSTONE.

Craiglockhart Hydropathic, near Edinburgh,
7th December, 1880.

DIAMAGNETISM.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In Guthrie's "Magnetism and Electricity," p. 347, there is an experiment to prove the polarity of diamagnetism. This experiment is not sufficiently conclusive, and I should like to know whether it is possible to get *attraction* of a diamagnetic bar. For instance, let a current pass through C (Fig. 300) in such a direction that *a* would become N, and *b*, S pole, if it were iron. Now, let currents pass through E and F so that *e* becomes N, and *f* becomes S. Would *a* and *b* be attracted by *e* and *f* respectively?—Yours, &c.,

J. W. W.

December 6.

BATTERY FOR ELECTRIC FUSE FIRING.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Will you or some of your readers kindly tell me the names of any books which would give me information respecting the methods used for firing charges of gunpowder by electricity in blasting operations, cannons, and the like. Also, what is the best, smallest, and most portable battery for this purpose, with approximate size and weight? If there is no book which treats of this I should be much obliged if you or your readers would give me any particulars.—Yours, &c.,

J. E. W.

Arthington, Torquay, Dec. 6th, 1880.

THE SOCIETY OF TELEGRAPH ENGINEERS.

Never since Professor Bell first described his telephone to the members of this society has a larger audience assembled than that before which Mr. W. H. Preece introduced the latest, if not greatest, of the Professor's remarkable achievements on the evening of Wednesday, the 8th instant. The title of the lecture was "The Conversion of Radiant Energy into Sound," and its object plainly was to clear the ground for Professor Bell himself, who, arriving late from Paris, could only give a brief sketch of the final results of his experiments. Mr. Preece, at great pains and with much detail, described the various stages of discovery which had finally enabled Mr. Bell to conceive and successfully construct a photophone. Sound, the lecturer commenced by observing, is merely a sensation, and can hardly be said to exist except in its manifestation to the hearing, occasioned by a mechanical disturbance of the tympanum of the ear. This mechanical disturbance is set up by molecular movements in the medium surrounding the ear—generally the air, but as shown by experiment, wood and other sonorous, or sound conducting, media are capable of disturbing it in like manner. There must be first the transmitter where the sound originates, then the vehicle by which the vibrations travel, and lastly, the ear to respond and whisper its message to the brain. The whole process resembled the sympathetic vibration of one tuning fork to the vibrations of another—only in the case of the ear it appears to be in sympathy with every vibration that reaches it. The telephone was an example of undulatory vibrations producing sound with the aid of electric currents, as also were intermittent currents in producing musical tones. Directing attention to the phenomenon of radiant energy, Mr. Preece described the various steps leading to the conclusion that the actinic rays of sunlight were in like manner capable of producing molecular change, which if suitably interrupted, in other words set in vibration, would give rise to sound corresponding in tone and pitch with the speed and character of the interrupter. These surmises received a striking confirmation in 1873 by Willoughby Smith's discovery that selenium was peculiarly and instantly acted upon by light. A current passing through it immediately received a fresh impulse on this metal being exposed to luminiferous rays. Mr. Smith here showed the effect on a mirror galvanometer, the selenium in the circuit being for a moment exposed to the light of a lucifer match. A further illustration was afforded by Dr. Werner Siemens' selenium eye—a simple contrivance for exposing or obscuring a bit of selenium, mounted and joined in an electrical circuit. The lecturer gave it as the general opinion that the effect was not due to heat. But assuming it to be due to light only, the question still arose did the light merely reduce the resistance of the metal, or was an independent current set up in it by the action of actinic rays. In other words, was the action like that of a sensitive thermopile, or was it a molecular change tending to improve the conductivity of the metal. Professor Adams' researches pointed to the inference that there exists in selenium what may be called a photo-electric action. But we must postpone the remainder of our report until next week.

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CABLE-LAYING IN GUIANA.

BY J. MUNRO, C.E.

On the 27th of May, 1874, the telegraph ship "Hooper" arrived off the Para mouth of the Amazon River with a cargo of submarine cable on board. It was a time of extraordinary activity in cable-laying; and in the two preceding years the "Hooper" had laid cables all along the coast of Brazil from Para to Rio de Janeiro. Her present mission was to link Para, the capital of Brazilian Guiana, to Cayenne and Demerara by cable, and thus to connect the Brazilian cables to those of the West Indies and the United States. It was a trip, as it afterwards turned out, fuller of incident, perhaps, than any other cable expedition except the first Atlantic.

The "Hooper" is a large vessel of over 5,000 tons burthen, built expressly for the work. It had been the practice hitherto to take an ordinary steamer and fit her out with cable-tanks, testing-room, and laying machinery in the best manner possible; but the "Hooper" was the first ship specially built for cable-laying, as the "Faraday," of Messrs. Siemens Brothers was the next. She belonged to Messrs. Hooper and Co., the india rubber cable manufacturers, of Millwall, and the cables she carried were manufactured by them for the Western and Brazilian Telegraph Company, after the designs of Sir William Thomson and Professor Fleeming Jenkin, the company's engineers.

Her crew, like the crew of every telegraph ship, consisted of the captain, officers, and seamen for navigating the ship, the cable engineers and "cable hands" for attending to the mechanical operation of laying, and the electricians engaged in making the electrical tests of the cable. The captain, the cable engineers, and the electricians, inhabited the saloon, while the officers of the ship occupied the mess room, and the cable hands shared the fo'castle with the sailors, not, however, without a good deal of jealousy and grumbling on the part of Jack.

There is generally very little doing on a telegraph ship during the outward voyage. The real work of the expedition only begins with the laying. We whiled away the time in novel-reading, in writing essays for our "Literary and Scientific" Society, or in after-dinner talk on the quarter-deck at sunset. The saloon passengers of a cable ship are generally men of the much-wandering Ulysses type, men who have laid cables or put up land-lines in various quarters of the world, and who have their scraps of romance and adventure to reveal. It was pleasant as the sun went down, and fired the golden west before us, to sit and smoke on deck, and listen to snatches of real experience, instructive, exciting, humorous, pathetic, sometimes even poetical, and always interesting—tales of blockade running, of Australian exploration, of camping out in Persia or the Cape, recollections of Garibaldi's expedition or the Indian Mutiny, reminiscences of Venice, Cairo, Hong Kong, or Stamboul, interspersed with many useful "wrinkles," curious facts, and accounts of marvellous natural phenomena. There was a good deal of banter and repartee, too, and discussion of all manner of themes, as well as anecdotes upon all subjects.

We had amongst us a representative of the first Atlantic cable expedition, who bore a prestige something similar to that of a survivor of the Balaklava charge, and who loved nothing better than to find himself the centre of a circle of admiring hearers. It was his custom then to favour us with some select morsels from the unwritten history of that great undertaking. He was wont to tell us of the wonderful coolness of Sir Samuel Canning, the engineer of the expedition, who at that disastrous moment when the end of the cable parted at the stern of the ship, to vanish into the Atlantic, turned quietly to our storyteller, and simply said, "Have you got the time, Mr. B." We were never tired of hearing, too, of that critical time on board the "Niagara," when the "continuity" signals from the "Agamemnon" failed, and it was feared that the cable was broken between the two ships. There was an anxious gathering of the scientific chiefs in the little testing cabin, where the end of the cable was connected up to the galvanometer for testing. It was like a surgical consultation over some fatal accident. Professor Thomson, seemingly overpowered by the thought of failure, kept his eyes rivetted with a half-despairing look on the mirror of the testing instrument, as one watches for a last breath from the lips of a dying man; Mr. Bright stood by, biting his nails as if he were bewildered; Mr. Canning was grave, but self-possessed; the captain, from behind, dubiously watched the testing, while the sailors crowded round the door and peered over each other's shoulders with confused and wondering faces. After some minutes of painful suspense a feeble quiver of the needle was observed, and this death-bed scene was turned to one of almost frantic joy—the cable was sound!

When we left Gravesend on May-day, the nightingales were singing in the Kentish lanes, and the meadows were speckled with daises. We halted a few days at the superb island of Madeira, with its vine-clad terraces and violet atmosphere; then, after a run of a fortnight over the deep blue of the Central Atlantic, and through, perhaps, the purest atmosphere on earth, we entered the dull bottle green waters off the Amazon mouth, and could distinguish the dark fringe of the immense primæval forest which shrouds the valley of the great river up to the base of the Andes. Dull green and savage near at hand it was broken up into clumps of trees by the mirage of the tremulous heated air, and gradually dwindled away into the distance.

Off the Indian fishing village of Collares, whose red-tiled roofs nestle at the roots of the lofty forest, we took on board a pilot from the lightship, and proceeded up the Para, or southern mouth of the river, towards the city of Para, which is situated seventy-five miles from the mouth, and is the only port for the vast and inestimably rich and fertile plains of the Amazon.

It was a burning tropic day, and, as is usual in this equatorial region, there was thunder in the air. All around rolled the brimming yellow flood of the river full up to the dense wall of forest on the left, and the shaggy Eden-like islands on the right. Down its rapid tide many waifs from the interior, cedar logs, dyed reeds, and broken lillies were floated past. The sun streamed down his vertical rays, and sultry clouds hung about the horizon. Close under the main bank of the river where the water appeared cool, smooth and glassy, we could see by our glasses the canoes of native fishermen gliding under the towering forest like tiny paper skiffs, the red brown skins of the half naked Indians contrasting savagely with the dull green of the tropical foliage.

Nature here is on a wild and magnificent scale. At its mouth the Para river, as the southern branch of the Amazon is called, is thirty-six miles wide; at the City of Para it is still twenty miles wide, but the channel becomes so filled up with islands below and above Para that the river there appears only a few miles broad. These islands, which have originally sprung up out of sand banks, are virgin wildernesses treacherously beautiful, and sometimes so overgrown with vegetation as to resemble a tangled hop garden.

In the evening, while the setting sun from behind the western forest filled the broad river scene with his rich golden lustre, we came to anchor in front of Para between the city and the islands, out in mid-stream. Para stands on a small promontory of low land jutting into the river. It is a chimneyless tropic town, with flat, red-tiled roofs, and whitewashed walls, interspersed with the glittering crests of palm trees, and the luxuriant foliage of the bread-fruit, while here and there rise the ornate towers and cupolas of some grey Portuguese convent or cathedral. All behind, the primæval forest hems it in, ever ready to encroach and regain its lost ground. The anchorage in front was full of native craft, manned by Indians and negroes, American schooners with flour from Boston, European ships lading rubber and Brazil nuts, indigo, and cacao, and the white and scarlet river steamers of the Amazon Company, which ply between Para and Manaos at the mouth of the Rio Negro 800 miles up stream, and carry down the produce of the interior, cinchona, indigo, sugar, cashass (rum) in exchange for jerked beef from the island of Marajo, clothing and provisions.

On board the "Hooper" we now began to make arrangements for laying the cable. The salt water which had been allowed to soak the cable during the voyage was now pumped out of the cable tanks, leaving the cable in a damp coil at the bottom of each. Some "faults" or flaws in the insulator, which had developed themselves in the hot atmosphere of the tropics, had to be cut out, and the pieces of cable to be laid had to be made up into one length.

A submarine cable, as is well known, consists of a stranded copper wire or conductor enveloped in a thick skin of gutta percha, india rubber, or some other insulating material. The wire conducts the electric current, and the insulator confines the current to the wire, or, what comes to the same thing, prevents it from escaping to the sea water, or "earth," as it is called. The wire and insulator form the "core" or part of a cable essential to the transmission of the electric current, but in order to guard the core from mishap and to render it strong enough to bear the strain of laying and repairing operations, it has to be strengthened by an outer sheathing of tarred hemp and galvanised iron wires. The shore portion of a cable being that most liable to mishap from anchors, storm-waves, or boulders, it is usual to sheathe the "shore end" very heavily. The "main" cable, or deep sea portion, is generally deposited at great depths out of harm's way, and is, therefore, lightly sheathed; while the "intermediate" type, which comes between these, is of intermediate strength. These three types of cable are stored in the tanks in the order in which they are to be paid out. The "Hooper" had three tanks, and paid out, of course, from her stern; therefore the Para shore end occupied the stern tank, the Para-intermediate, main, Cayenne-intermediate, and Cayenne shore end following in order.

The laying of a submarine cable has been reduced to a science. The arrangements on board a telegraph ship are now in the main everywhere the same. The cable is usually laid under the entire responsibility of the contractors who make it. To them belongs the ship, and all the operations of laying are conducted by them, subject to the approval of a staff of engineers, representing the company's interests, who are temporary guests on board. The head of the expedition is the engineer-in-chief, who directs by aid of his assistants the mechanical operations of laying. Under him are the chief electrician, whose duty it is to see that the cable is laid in good electrical condition, and the captain of the ship, whose office is simply to manœuvre the ship in accordance with the requirements of laying. A fully equipped telegraph ship must be fitted with the necessary machinery for carrying and laying the cable, with proper electrical apparatus for testing it, and also with the most approved means of navigation; for it is of the utmost importance in case of future repairs to be able to lay down on a chart the exact course of the ship, since this is also the exact route and position of the cable. Besides her cable tanks she has force-pumps for filling sea water into them or drawing it off; she has a huge laying machine, consisting of a friction brake, strain dynamometer and drum; she has a powerful steam winch for coiling over cable from one tank to another; and in addition to these she has a store of grapnels for hooking the cable in the sea, and buoys for marking positions or buoying the end up at the surface when it becomes necessary to do so. Projecting from the stern there is fitted up a large deeply-grooved wheel or pulley of iron which revolves on a fixed axle, and is generally surrounded by a narrow platform with a railing round it. This is the "stern sheave" or pulley over which the cable passes on its way to the sea; and this, as well as the red-painted buoys lashed along the taffrail, is one of the distinguishing features of a cable steamer.

While the cable was got ready for laying, we electricians had plenty of leisure to land and ramble about on shore. The "City of Belem," or "Para," was founded as long ago as 1616, by the Portuguese Cadeira. At that time the Amazon, or "mighty Orellana" was a fabulous river, flowing through the magical regions of El Dorado, whose banks were peopled by a warlike tribe of Amazons, and whose sands were sprinkled with diamonds. Time has disenchanted it of its imaginary wealth and glory, but the real natural riches and wonders of its forests which have been revealed have amply atoned for the loss. Last century, when the Portuguese looked to Brazil as their future seat of empire, they built large convents, palaces, and public buildings at Para, for they anticipated that it would become the emporium of the Amazon valley. At the present day these grand edifices are falling to decay. Para has, until lately, been declining rather than advancing. The revolution of 1835 checked its development to an extent from which it has not yet fully recovered. The native Brazilians, leaguing themselves with the Indians, who had been hunted and enslaved by the Portuguese settlers, attacked the latter and overthrew the Government. It was years before the country was tranquillised, and the consequent insecurity to life and property, together with the heavy impost duties imposed by the Brazilian Government, has repelled immigration. Within the last twenty years, however, there has been a marked revival of trade and enterprise. The dilapidated city has been in great part renovated.

(TO BE CONTINUED.)

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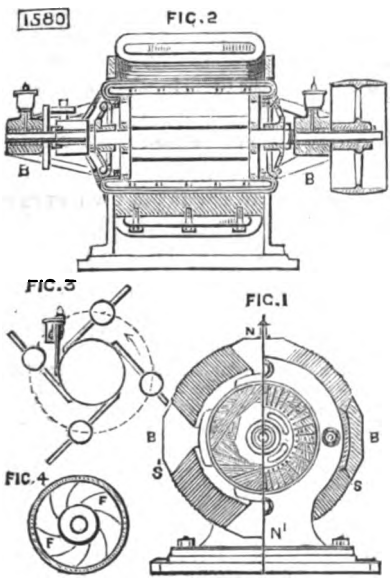
ABSTRACTS OF SPECIFICATIONS.

—o—

We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts—ED. *E.*]

1580. DYNAMO-ELECTRIC MACHINES, *E. P. Alexander. Dated 17th April*, 1880.—(*A communication.*) 6*d*.

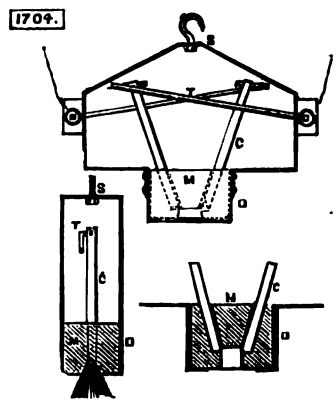
The inventor aims at producing a machine to give currents of great tension, to have a slow speed of rotation, and to be free from heating. A cylindrical armature wound longitudinally is carried on bearings in the frame B B, and rotated within the ring-shaped magnets N S N^1 S^1. Sometimes the core of the armature is made of wrought iron plates, of which the continuity is interrupted. For continuous currents the core is made of spiral-shaped rings of wrought iron insulated wire wound round a cylinder of non-magnetic material. The coils of the armature are wound in the form of rectangles, having their long sides parallel to the axis, the width of each coil being such that its two sides are at the same time approaching and leaving two of the fields of opposite polarity of the electro-magnet, so that currents of like direction and force are at the same time induced in both sides of each coil. In order to diminish wear of the commutator plates and keep their surfaces clean they are lubricated by pure petroleum. For this purpose a vessel containing the petroleum is fixed above the commutator with a porous wick extending down from



it so as to bear tangentially against the cylindrical surface of the commutator. The armature is made hollow with openings through its ends and its periphery, so that currents of air may pass through it to keep the machine cool. The ring-shaped magnet consists of an iron ring wound over sections of its circumference with coils of insulated wire, so as to produce a number of successive magnetic fields of alternating polarity. The currents are collected as usual, part being used to excite the machine magnets, and part for external work. From the driving pulley polar extensions project inwards, so arranged that those of opposite polarity follow each other. The currents produced during a revolution change in sign, according to the number of polar extensions, thus X in number gives X changes, which may form X circuits to be combined as desired. The inventor claims, first, the construction for continuous currents; secondly, electro-magnets with polar extensions; thirdly, the coiling of the wire in armature in rectangles; fourthly, the ventilation of the armature by openings at the ends, and the use of internal oblique vanes, F F, Fig. 4; fifthly, the lubrication, as shown in Fig. 3.

1704. ELECTRIC LAMPS, *H. J. Haddan.—Dated 26th April*, 1880.—(*A communication.*) 6*d*.

The electrodes of lamps on the arc type are surrounded by a block of refractory material, preferably marble, so arranged as to guide the carbons and partially protect the points against air currents, reducing the carbon consumption considerably. The inventor says the carbons advance by their own weight or by the aid of springs, &c. Fig. 1 is a side elevation; 2, a cross section; 3, section through carbon guides. S is the frame, D case containing M, the refractory material, T T bars turning on centres and conducting currents to carbons, C C carbons. The inventor claims, first, the refractory material as a guide; secondly, as preventing air access; thirdly, so cut to distribute light as required; fourthly, the combination to connect carbons in circuit; and, fifthly, the whole combination. "This system of lamps is based on a new principle, which consists in surrounding the electrodes of the voltaic arc type of electric lamps by a block of refractory material—for instance, marble, which protects the poles against the air, compels the voltaic arc to take a prescribed line, and may be used to give a special tint to the electric light. For this purpose the contiguous extremities of the carbons are embedded in the refractory material, and the latter cut out so as to form a vault directed towards the side which is to be illuminated. At the top of this vault are two orifices which communicate with the points of the carbons, thereby forcing the arc to take the prescribed way. This principle reduces the consumption of the carbons by protecting them against the destructive action of the air—that is to say, by avoiding more or less their combustion; it secures also by the high temperature of the refractory block a disaggregation of the carbons favourable to the formation of the voltaic arc, and permits the application of currents of small quantity. The carbons are made to advance in proportion to their consumption either by their own weight or by means of counter weights and springs. The lighting of the lamp



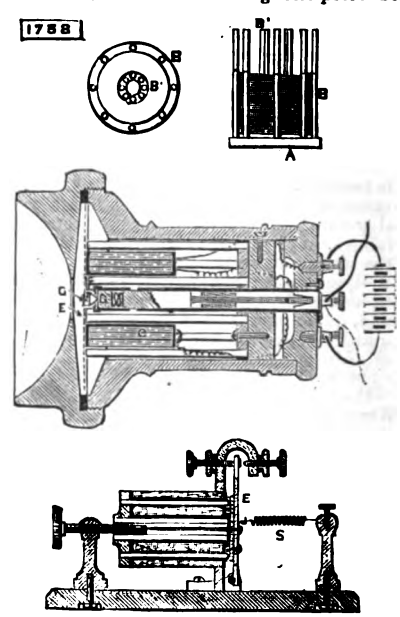
is effected by means of rods of plumbago or other suitable material connecting the carbons through the said orifices. For operating the lamps continuous or alternating currents may be used as desired. The carbons may form any desired angle against each other, and may even be placed in two different planes. In view of the small quantity of electricity necessary, the shape and dimensions of the carbons may be greatly varied. One of the carbon electrodes may be replaced by a metallic electrode. The refractory material employed may be formed of one or more pieces joined together, or simply placed near each other; it can be cut out like a vault so as to distribute the light in the direction desired, and the shape of the vault may vary according to the nature of the space to be illuminated. This lamp makes any mechanism or superintendence unnecessary, and permits a prolonged use with carbons of small length. I am aware that blocks of refractory material have been used for guiding the electrodes and for limiting their motion. I do not, therefore, claim the application of refractory material generally, but the special manner of applying the same, whereby its function becomes essentially different from that hitherto assigned to it. In the lamp herein described the refractory material serves to force the arc, that is to say, to compel it to take away from which it cannot deviate. Experience has shown that this is the only means of obtaining by an arc an absolutely fixed light. In the lamps hitherto used the carbon points are visible, exposed to the air, and therefore subject to rapid combustion. In this lamp, however, the carbon points are not seen, the light being produced by the heating effect of the carbon vapours of the voltaic arc on the incandescent material, and the colour of the light is that of the heated refractory material, generally a peculiar gold colour. The voltaic arc touches the refractory material on its entire length without effecting any appreciable destruction. The present arrangement has also the advantage of protecting the arc against cooling, and thus increasing the useful effect, the length of arc obtainable being greater than in other lamps. As the carbons only serve to produce carbon vapours, their shape and dimensions as well as their quality have no great influence on the light."

1705. LIQUID COMPOUND FOR THE ELECTRO DEPOSITION OF ALUMINIUM, *L. A. Davies.—Dated 26th April*, 1880.—(*Not proceeded with.*) 2*d*.

To common alum is added ammonia, the precipitate formed being alumina. This precipitate is then thrown on to a filter paper and washed, and redissolved in a hot solution of neutral tartrate of potash. This solution is then evaporated nearly to dryness and redissolved in sulphuric acid. This salt is then crystallised out of the solution and the crystals dissolved in water. This solution forms the bath, which is then ready to be used for the deposition of aluminium.

1738. IMPROVEMENTS IN PERMANENT AND ELECTRO MAGNETS AND ELECTRIC TELEPHONES AND TELEPHONE CIRCUITS.—*S. Russell.—Dated 28th April*, 1880. 6*d*.

The inventor's ideas with regard to electro-magnets will be best gathered from the illustration. The figures show an end view, and a longitudinal mid-section, partly wound. From the plate A two annular series of slender bars B B, B^1 B^1, those marked B B being arranged at the circumference of the plate, those B^1 B^1 concentrically near the centre, the number and sizes of the bars in each series being equal. The wire is wound in the space between the two series of bars as shown at C. The inventor claims that such magnets when used in telephones increase greatly the sensitiveness of the instrument. In the remaining figures the magnet, the coil, the case of the telephone, and the other parts are shown with the magnet arranged electro-magnetically with an armature, E, having a retracting spring, S. The magnet used with a telephone transmitter is shown, and it is stated that the magnetic poles being



slender, vibrate in sympathy with the diaphragm. The coil C is here borne by the diaphragm E and vibrates with it, while the poles vibrate laterally. As the coil vibrates it moves to and from the neutral position of the magnet, and thus varies the mutual inductive actions, increasing the sensitiveness and power of the instrument. E is made of wire gauze instead of sheet iron, the interstices being filled up by hammering. The larger figure shows an arrangement of transmitter and receiver. The transmitter is arranged at the centre of the magnet. It consists of two resistance-varying contacts, G G^1, the contact G being fixed to the centre of the diaphragm, and the contact G^1 pressed lightly against it. The contact G is preferably of metal, with a platinum tip, and the contact G^1 is preferably a button or block of carbon, but other materials may be substituted for them.

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THE CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
French Government	ss Ampère	—	—	—	—
Telegraph Construction	ss Calabria	3,325	300	—	Victoria Docks.
Henley's	ss Caroline	526	70	—	North Woolwich.
French Government	ss Charente	—	—	M. Dufour	—
Eastern	ss Chiltern	1,304	200	W. Goodsall	London.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Algiers.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	W. F. Wardroper	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	A. Killett	Victoria Docks.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Canadian Government	ss Newfield	785	90	R. A. Guildford	Canada.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Great Northern Company of Denmark	ss J. B. Oersted	580	120	—	—
Paris and New York	ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	At Malta.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	—
Telegraph Construction	twin screw Scotia	4,667	550	W. R. Cato	Atlantic
Telegraph Construction	ss Seine	3,579	500	H. Manning	Victoria Docks.
Eastern Extension	tw screw S. Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	—	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.
Great Northern Company	ss Store Nordiske	832	120	—	—
International Ocean Telegraph Company of America	tw sc Prof. Morse	900	—	—	Key West, U.S.
West India Telegraph Company	Duch. of Marlboro'	402	—	—	—

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Dec. 8.		Business Done Week Ending Dec. 8. Highest.	Lowest.
Anglo-American Ordinary	64¼,	¾	66¾	64¼
Do. "B"	93½,	94½	95¼	93
Do. "A"	35½,	¼	37½	35½
Brazilian	9 15-16,	10 1-16	10½	9 13-16
Cuba	8½,	9½	9½	9½
Do. Ten per Cent. Pref.	16,	½	—	—
Direct Spanish	2½,	3½	3½	3½
Do. Ten per Cent. Preference	12½,	13	12¾	12¼
Direct United States	12½,	¼	12¼	12½
Eastern	9½,	¾	9¾	9½
Do. Six per Cent. Debenture	102,	104	—	—
Do. Five per Ct. do. 1899	102,	104	105	105
Do. Six p Ct. Pref	12½,	13	13	12½
Eastern Extension	10 1-16,	3-16	10½	10½
Do. Six per Ct. Deb	108,	111	110½	110
German Union	10,	¼	10	10
Globe Telegraph & Trust	6¾,	7	7	6 7-16
Do. Six p Ct. Preference	12½,	¾	12¾	12½
Great Northern	10¾,	11¼	11	10¾
Indo-European	25,	26	—	—
Mediterranean Extension	2½,	3½	—	—
Do. Eight p Cent. Pref	10½,	11½	—	—
Reuter's	10¾,	11¼	11	11
Submarine	255,	265	259½	259½
West India and Panama	1 15-16,	2 1-16	2 5-16	1 15-16
Do. Six per Cent. 1st Preference	6¾	7½	7½	6¾
Western and Brazilian	8¾,	9	9½	8 11-16
West. Union 7 p. Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	104,	107	—	—

TRAFFIC RECEIPTS FOR NOVEMBER, 1880.

Companies.	Nov., 1880.	Nov., 1879.	Increase.	Decrease.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	1,900 estd.	3,110	—	1,210
Direct United States Telegraph Company	—	—	—	—
Direct Spanish Telegraph Company	1,465	1,334	131	—
Eastern Telegraph Company	47,669	46,147	1,522	—
Eastern Extension Telegraph Company	29,724	26,379	3,345	—
Great Northern Telegraph Company	20,800	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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SLIP

PHILADELPHIA.—The Sawyer light is being tried at the Mercantile Library at this town.

ISLE OF WIGHT.—The Hurst Castle cable is now repaired, and communication with the island restored.

THE SOCIETY OF TELEGRAPH ENGINEERS.—The next meeting of this society will take place on the 22nd inst.

THE LONDON INSTITUTION.—The lecture on Thursday night was by Dr. O. J. Lodge, on "The Relation between Electricity and Light."

THE BRUSH LIGHT.—According to the prospectus of this company over 2,000 of these lights are in use in America, and nearly 500 are in use or ordered in Great Britain.

EASTERN EXTENSION TELEGRAPH COMPANY.—The directors of this company have declared an interim dividend for the quarter ended with September 30, of 2s. 6d. per share, being at the rate of 5 per cent.

BLACK SEA TELEGRAPH COMPANY.—At a meeting of this company, held at 66, Old Broad-street, on Thursday last, the report and accounts to the 30th September last were received and adopted, and a dividend of 5 per cent. was declared.

THE POST OFFICE AND THE TELEPHONE COMPANIES.—At the moment of going to press we learn that judgment in this case will be delivered on Monday next. It is confidently stated that there will be an appeal whatever may be the decision.

THE ELECTRIC LIGHT.—The directors of the South-Eastern Railway have decided to experimentally light their Charing-cross Station with the Brush system of electric light, and the Cannon-street Station by that of the British Electric Light Company.

THE EDISON COMPANY.—The stockholders of the Edison Electric Light Company met on the 1st and increased the capital stock of the company 180,000 dollars, making it in all 480,000 dollars. This increase is to pay for past expenses and to assist Mr. Edison in future experiments.

USE OF THE PHOTOPHONE.—It is suggested by the *Revue Industrielle*, that Professor Graham Bell's new instrument may with advantage be used for communication between ships and lighthouses. It is difficult to see how such communication could be carried out with a moving body like a ship.

ELECTRIC LIGHTS ON THE THAMES EMBANKMENT.—We recommend little boys not to congregate underneath the Jablochkoff lights as evening approaches. A shower of sparks descended from one of these lamps the other evening on being first lit up and scattered the unsuspecting juveniles most incontinently.

WEST INDIES AND GUIANA.—The St. Croix, St. Thomas, and the Antigua, Guadeloupe cables are now repaired, and communication is restored between these places and Dominica, Grenada, Martinique, St. Lucia, and Trinidad. Communication, however, with Barbadoes, Berbice, Demerara, and St. Vincent is still interrupted.

THE PHOTOPHONE.—As might be expected the photophone is giving rise to many novel experiments and suggestions. A correspondent asks whether intermittent *magnetic* rays would not in all likelihood produce sound in a body upon which they are directed? He should try for himself. Some ingenuity will be needed to shut off the local noise occasioned by the act of interrupting.

THE BRUSH COMPANY.—The energy displayed by this company is gratifying. The English people will have to adopt the electric light whatever betides. Really it was time some one with a little business tact and push appeared upon the scene. Whether the light be good, bad, or indifferent, is not now the question; but if success in business comes by hard work there be those that command it.

BRITISH MUSEUM.—Last Saturday afternoon one of the four Siemens lamps which illuminate the reading room, after playing some vagaries, went out and was not induced to burn for some little time, the readers in that part of the room being left in comparative obscurity. Such accidents are explainable and excusable; but to admit that they are unavoidable would be fatal to electric lighting. Every effort should therefore be directed to render them impossible.

OTTAWA, ONT.—The European, American, and Canadian Cable Company will apply to Parliament for an act of incorporation during the coming session. The eastern end of the cable will land on the Scilly Islands, connecting with the Government cable at Sable Island, which will be laid early in the spring. They will be allowed to land on Sable Island, but not to take the cable off, this being Chief Electrician Disborn's plan for destroying the cable monopoly. The bill will limit rates to one shilling per word.

THE GERMAN VIEW OF TELEPHONIC PRETENSIONS.—According to Article 48 of the Constitution, the Telegraph is an institution of the German State. It follows (*sic*) that the construction and establishment of telephonic systems as a means of communication can only be undertaken by the State Telegraph Administration. The Minister of the Interior has just addressed the provincial governors directing them to order the police to prohibit the establishment of telephonic communication, the State reserving to itself the exclusive right of undertaking such works.—*La Lumière Electrique.*

THE WEATHER IN SCOTLAND.—A telegram from Scotland says:—Snow has fallen heavily to-day in the northern counties of Scotland, and apprehensions are entertained of railway blocks. Consequent upon the breakdown of the telegraphic communication the reports of the violent gale which raged from Friday till yesterday in Orkney and Shetland are only now being received. The mail steamers were unable to cross the Minch or Pentland Firth for three days, and the cable between Longhope and Wick has suffered so much that it is doubtful if communication can be restored this winter. Four vessels were in danger at Scrabster on Friday, but the crews were rescued by the coastguard.

THE NEW MEXICAN TELEGRAPH.—The ss. "Dacia," Captain Hayward, belonging to the India Rubber, Gutta Percha, and Telegraph Works Company, left Greenhithe on the 8th with the first section of the Mexican cable, including all the shore ends. Mr. E. March Webb, chief electrician, is in charge during the passage. The ss. "International," Captain Wardroper, cleared out on the 15th with the remainder of the cable and the testing and working instruments made at the Silvertown Works for the Mexican Telegraph Company, Mr. Theophilus Smith in charge. Mr. R. K. Gray, engineer-in-chief to the India Rubber Company, proceeds by mail to Kingstown to meet the ships and superintend the work of laying the cables.

THE INTERNATIONAL CONGRESS OF ELECTRICIANS AND EXHIBITION.—The French Government have laid on the table of the Chamber a demand for a grant of three hundred thousand francs in favour of the International Electricity Exhibition and Congress. The Government points to the patriotic sentiments with which the subscribers of the guarantee fund are animated, and begs the Chamber to participate in a work which must prove most valuable to the advancement of a science which has lately made such rapid

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strides, and which promises to render such great additional services to the whole civilised world. One hundred and fifty thousand francs are applied for in favour of the Exhibition itself, but the Government, wishing to keep the direction of the Congress in its own hands, asks for another one hundred and fifty thousand francs to cover all expenses.

A Reminder.—We beg to remind Mr. Edison that he announced, three months ago, that he had perfected his patent bamboo-fibre—or whatever else he called it—for his carbon loop; that one agent was then canvassing the lower part of New York city; that the gas peoples' "days" were "numbered," and that his wires were to be laid here "in December." This is December 1st, and as Mr. Edison has been making lamps all summer, and has accumulated several thousands of them, we trust he will make the light a complete success in December, according to promise. We will accord him honour commensurate with his achievements; but, as Mr. Edison has earned the reputation of being an exceedingly uncertain kind of a person, we have not yet become enthusiastic, although he seems to have borne in mind "the chorus of abuse and ridicule which greeted him in January last."—*The Operator.*

Any Excuse is Better than None.—The chairman of the Peninsular and Oriental Steamship Company, at the annual meeting of the company last week, when describing the five new ships ordered to be built said, "The question of lighting ships by electricity had been much before the public of late, and had in relation to these new ships specially engaged the attention of the board, but after deputing a member of their engineering staff to inspect some of the ships now electrically lighted, and having regard to the fatal accident which had lately occurred on board the 'Livadia,' they had decided to defer adopting this system of lighting until it had been further tested and had assumed a more perfect shape." The audience cried "Hear, hear." Seldom has a more painful display of prejudice been made public. These sapient directors might as reasonably give up steam because a boiler exploded through bad management. Of course they have discarded gas because of its many dangerous properties. In the electric light they have a perfectly safe, as well as a pure light, and one which commends itself pre-eminently for use on board ship. The Peninsular and Oriental directors, having been rudely awakened by the competition with such lines as the Orient, have decided to build a better class of vessel, but they will still find themselves behind the age if they refuse to adopt improvements upon such grounds as those above mentioned.

The Western Union Telegraph Company.—President Green of the above company thus sums up the work of the year: "We have been constructing largely during the past year, and I think built more miles of line than the American did with all its boasting. From July 1, 1879, to October 15, 1880, we put up 28,000 miles of wire. We now have 243,000 miles under our control, while the entire amount of wire in the country does not exceed 300,000 miles. As for new schemes, we expect before next spring to have a new line to the Pacific coast. We have built east along the southern division of the Central Pacific, which has been extended to El Paso. The Texas Pacific is not yet near that point. However, that road is under Jay Gould's control, and we probably would not be able to run our lines over it any way; but we shall make connection by the Atchison, Topeka, and Santa Fe, on which we are now extending our wires westward. I am hopeful that the two sections will be joined as early as January, and then we shall have a through line from St. Louis to San Diego and San Francisco *viâ* the Southern Pacific. This is the largest project on foot just now. We are building lines in various parts of the country, notably one or two long ones up into Oregon. An improvement lately introduced by us is the use of the No. 4 gauge wire, the largest ever employed in telegraphy. It was never used in this country till last year. We are now working from New York to Chicago in one circuit of 1,050 miles, and a quadruplex circuit at that, transmitting four despatches at the same time; a feat we are able to perform by the use of this wire."

The Electric Lift of Dr. Siemens.—Hydraulic lifts for large hotels and depots are very costly, and Dr. Werner Siemens has made a useful innovation in the application of electricity to the movement of the cage. It is as safe as the hydraulic lift, and far less costly and inconvenient. It operates through the transmission of power by the dynamo-electric machine, and the first one was put in operation recently at the Industrial Exhibition of Mannheim, where during the few weeks it was exhibited it lifted over 8,000 persons, the speed of the cage or chariot being half a metre per second. The apparatus consists of a stationary dynamo-electric machine, which is intended to generate the current, and a second or receiving dynamo-electric machine, which is carried in a box below the platform of the lift. The lift is suspended by two wire ropes passing over a drum, and it is counterpoised by a weight, so that the work to be done by the current in raising it is very little compared with the whole weight of the lift. These wires act also as conductors of the current connecting the two machines. They form, in fact, the return wires. The lifting of the carriage is effected by means of a central ladder or rack, with its rungs or teeth very close together, and two toothed wheels connected to the bottom of the carriage gear with this rack. These wheels are driven by the receiving dynamo machine through the intermediary of an endless screw on the axle of the armature. The sides of the ladder act also as a conductor conveying the current from the generator, and two revolving wheels carried by the frame of the carriage make contact with the sides of the ladder, and tap the current in order to lead it to the coils of the dynamo machine. The lift is started or stopped, raised or lowered, by means of a commutator handle.

More Rumours About New Atlantic Cables.—The *Daily Telegraph* of Tuesday last gives the following telegram from its own correspondent:—"New York, Monday. It is stated here to-day that subscriptions have been obtained for the amount required to complete two Atlantic submarine telegraph cables, and that the manufacture of them will be commenced immediately." A curious comment upon this appears in the *Financier* of Wednesday in the shape of a letter over the signature "Looker On." The following is the letter:—

THE ANGLO-AMERICAN TELEGRAPH COMPANY, LIMITED.

TO THE EDITOR OF THE "FINANCIER."

Sir: If the Directors of this Company henceforward augment by £100,000 their hitherto very insufficient appropriation of only £150,000 per annum to the Renewal Fund, the net profit on the capital of the Company will be £147,000, or 2 1-7 per cent. per annum. This result assumes that the increase of business consequent upon the reduction of the tariff to 2s. per word compensates for that reduction. Should it fall short of doing so, of course the profit would, *pro tanto*, be less. I need scarcely say that 2 1-7 per cent. on the capital would give 2 1-7 per cent. to the Ordinary Stock, 4 2-7 to the Preference, and nothing to the Deferred, which comes in for dividends only when the profit on the capital exceeds 3 per cent.

The grounds for this calculation of the prospective dividends under the prescribed condition are (1), the exceptionally large receipts of the Company for the year ending March 31st, 1880, and (2), the average working expenses for the last three half-

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years, these pieces of information being derived from the Reports of the Directors.—I am, &c., LOOKER ON.

If the arguments of the letter are correct, and if we consider that besides the Anglo-American we have the Direct United States and the New French Cable companies, the latter of which has as yet earned no dividend, and that none of the lines are fully worked, where, then, we ask, is the chance of benefit arising from investment in a new scheme?

A YANKEE'S VIEW OF THE EXCHANGE SYSTEM.—Joacquin Miller relates the following scene, familiar to most New Yorkers, but not to those who are less acquainted with the ways of this metropolis or the mysteries of Wall-street:—"I went to a broker whom I had met at the Union Club," says Mr. Miller, "and told him what I wanted to learn. He kindly took hold of the tape which continually streams out from the 'ticker,' as the little wheel of fortune is called, which constantly records the rise and decline of stocks, and tried to explain all about it. I found it impossible to get interested. There were about 200 different names of stocks on the list. These were represented by one, two, or three letters, or figures, or some sort of abbreviated word that I could not understand or distinguish, and I was constantly getting confused. Around this 'ticker' gathered and grouped a knot of eager, nervous, and anxious men. Ten, fifteen, or twenty at a time would clutch at the tape, as it streamed out with its endless lines of quotations, and mutter to themselves, jabber at each other, swear like pirates, drop the tape, and dash away. Others would dart in, clutch the tape, swear or chuckle as their fortunes went, wheel about, give orders to their broker to buy or sell, as they prophesied the future of the market; and so it went on all day from ten till three, when the battle was ended by the fall of the hammer in the Stock Exchange. When I tell you that there are more than 5,000 of these 'tickers,' or indicators, you can form some idea of the magnitude of the business. If we give ten men to each 'ticker,' you have the spectacle of 50,000 stalwart men standing there holding up a dotted strip of paper, waiting, hollow-eyed and anxious, on the smiles of fickle Fortune. To this 50,000 you may add 2,000 brokers. You must give each broker at least five clerks, office boys, and messengers, which swells the list 10,000. To this 62,000 you can safely add 200,000 speculators on the outside. So you have a total engaged in this gambling of more than 250,000."

INTERCEPTING A WAR TELEGRAM.—Every one interested in Afghan affairs recognises the excellent services done by the correspondent of the *Standard* at Candahar. But a letter of the Quartermaster-General recently published in India tells for the first time the story of the curious misadventure by which the *Standard* failed to profit by the enterprise of its representative. On the morning of the 3rd of September, it seems, Mr. Cameron, the correspondent in question, when on his way to join General Roberts's camp, fell in with some Afghan horsemen, who told him of Ayoub's defeat. Mr. Cameron turned back at once, and after a gallop of fifty miles met General Phayre, to whom he told the good news, and whose counter-signature he took the precaution of getting to the telegram he intended to send to the *Standard*. Unfortunately, he entrusted the precious missive, duly enclosed in an envelope, to an Afghan messenger for conveyance to Chaman, the nearest telegraph station. The man reached Chaman that afternoon, and was forthwith brought before Major Crawford, the officer commanding there. He had, says Major Crawford, "an open paper, signed by General Phayre, and addressed to the *Standard*." The commandant, "therefore" (we quote the despatch), "sent the news it contained first to Government, and Sir Robert Sandeman, and the Commander-in-chief, and then," indulgently, "allowed it to be transmitted to the *Standard*." From Quetta the news was at once sent to the *Pioneer* at Allahabad, where it was published that evening, and, it is believed, to *The Times*. The Government despatch did not reach Chaman until late next morning, "consequently," observes the Quartermaster-General, "Major Crawford's action deprived the *Standard* of the advantage of prior and exclusive intelligence of the victory." It must be a comfort to the *Standard* to know that Major Crawford has been admonished that in future in dealing with such cases he must give priority to the press message, and, in acquainting Government with intelligence, acknowledge the source from which it is derived.—*St. James's Gazette.*

THE TELEPHONE AT THE AQUARIUM.—On Friday evening, 10th inst., a lecture, entitled the "Telephone and its Prospects," was delivered here by Mr. Charlton Wollaston, C.E The Gower-Bell form of instrument was the one chiefly referred to by the lecturer, who stated that it had been adopted at the Admiralty, the dockyards, the India Office, the Trinity House, and by the Corporation of Swansea in connection with their waterworks over a distance of fourteen miles The Egyptian Railway Company has also, it is said, tried it over the whole distance from Cairo to Alexandria, 130 miles, and reported favourably on its performances. The original Bell telephone was, as is well known, short of power, and consequently faint in its articulation. It consisted of a small natural bar-magnet and a small thin iron disc. Mr. Gower has improved the construction by the use of a powerful bent horizontal magnet, the two ends of which are brought near together, and to these are attached two vertical poles, each surrounded by a coil of insulated wire. These act on a large stout iron diaphragm over three inches across, and, consequently, as the magnet, which weighs about one pound, can pull a weight of 16 or 18lbs., the amplitude of the vibrations of the disc is materially increased over that of the older instruments. Still further the intensity of speech-sending currents is increased by the combination of a modification of Professor Hughes's microphone with the Gower telephone. The modified microphone consists of an arrangement of six carbon pencils, radiating from a central carbon block to a series of outside carbon blocks, the whole being yet further assisted by a local battery with which the microphone is put in local circuit. This local circuit goes through the primary of an induction coil, the telephone and the carrying line being in connection with the secondary. The whole of this apparatus is contained in a neat box, the lid of which, varnished and placed at a slight angle, is at once the receiver of the voice and a sounding board. Two ear-tubes are attached to the box, so that other sounds may be shut off from the ears than those transmitted in reply and so the operator can speak and listen with the greatest ease and convenience. When it is desired to make the transmitted sound audible to an audience a sort of speaking trumpet or resonator is attached to a Gower-Bell telephone, and the sounds then become clearly audible. On this occasion the wires were laid on between Messrs. Siemens's factory at Charlton, near Woolwich, and the Aquarium, and were tapped also at Dr. Siemens's offices at Queen Anne's-gate. The notes of a bugle, various airs played on the cornet, and some songs were plainly heard by the audience, the notes of the music coming out very sweetly as well as clearly. The lecturer considered there was a high future for telephonic communication, and especially for the instrument he had described.

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CORRESPONDENCE.

PROFESSORS AYRTON AND PERRY'S CRITICISM OF EXNER'S PAPERS ON CONTACT ELECTRICITY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I am sorry to see that I have made an erroneous statement in the last paragraph but two of my letter of November 24th. The sentence should read, "In fact in air the iron is more subject to chemical action, and the gas film on it is positive; in H_2S the copper is more attacked and the gas film on it is positive; when covered with sulphides neither is attacked, and neither gas film is positive."—Yours, &c., J. BROWN.

Belfast, Dec. 13th.

EARTH CURRENTS.

By ALEX. J. S. ADAMS, of the Postal Telegraphs, Associate Telegraph Engineers.

(CONTINUED FROM PAGE 8.)

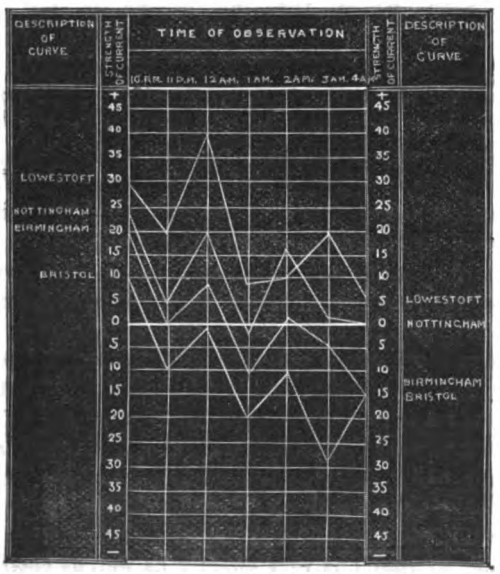
Instead, then, of having only one wire for our observations, we have eight wires radiating in various directions from London as a centre, and it will be our purpose to compare—for the same moment of time—the strength of the earth currents that present themselves upon these wires. They are connected to the earth at London, and at the places to which they severally extend, whilst by means of a switch arrangement we are enabled to insert a sensitive galvanometer upon any at pleasure. It is surprising how quickly the strength of the current manifested upon each wire may be noted by a little practice and dexterity.

OBSERVATIONS.

Point to which the wire extends.	Strength of the Earth Current at						
	10 p.m.	11 p.m.	12 a.m.	1 a.m.	2 a.m.	3 a.m.	4 a.m.
Bristol	+ 10	− 10	0	− 20	− 11	− 28	− 14
Birmingham .	+ 20	0	+ 8	− 12	+ 2	− 4	− 9
Nottingham .	+ 23	+ 5	+ 20	− 3	+ 17	+ 2	+ 0
Lowestoft ...	+ 32	+ 20	+ 40	+ 7	+ 10	+ 20	+ 12
Margate ...	+ 15	+ 15	+ 18	− 5	0	− 2	− 10
Brighton ...	0	− 7	+ 10	− 30	− 17	− 11	− 30
Southampton	− 7	− 17	− 10	− 28	− 25	− 48	− 2
Salisbury ...	+ 11	0	+ 3	− 7	− 13	− 30	− 15

The first series of observations we take at 10 p.m., and note the result in the first column, other observations being made at intervals of an hour up to 4 a.m., and similarly recorded.

Now, as the figures stand little or nothing can be made of

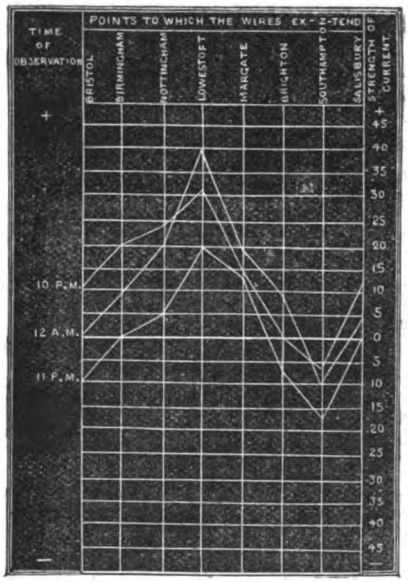


them, but if the figures are reproduced in the form of curves of comparative strength we get something more tangible, for although any of the above curves taken alone is confusing, when compared with one or more of the others an important feature presents itself in that there is a remarkable *coincidence of variation*. Thus, whilst the Bristol earth current falls from + 10 to − 10, the Birmingham current also passes from + 20 to zero, and the Nottingham from + 23 to + 5, all which are distinctly proportionate, a feature that would present itself in the results of any similar system of observation.

Here, then, we learn that the earth current, instead of being a localism—existing upon one or more wires to the exclusion of others—is more or less present upon all wires, the variations upon one wire being an index to the variations of any other for the same time.

The above figures, although the results of actual experiment, will admit of further investigation and analysis, for by taking the figures *transversely*, *i.e.*, directly down each column, instead of along the line from left to right, and reproducing them in the form of curves, we should be able to determine whether the earth current be a vagrant wanderer, or whether it takes some definite direction.

DIRECTIVE FORCE CURVES.

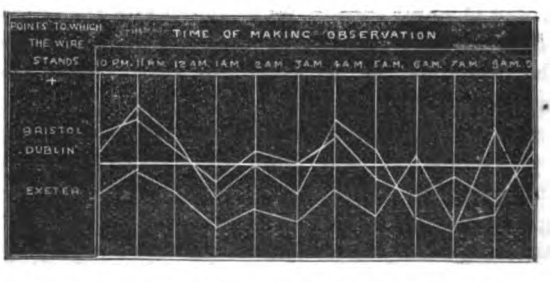


Such curves of directive influence represent the particular state of the earth current upon each wire at the time of observation; thus at ten p.m. there is presented to us the fact that whilst upon the Lowestoft wire the current is most strongly positive, upon the Southampton wire it is most strongly negative, and those two points may be considered as occupying the extremities of a line running nearly N.E. to S.W. through London. Moreover, if we take + as representing a current *coming in* at London, and − as a current *going* out, we have a flow of current in a line nearly N.E. to S.W., *i.e.*, in the direction from Lowestoft to Southampton.

Here, then, we arrive at the fact of *directive influence* in the earth current, and I shall hereafter seek to show that that line of direction about N.E. to S.W., or *vice versa*, is the rule, and a law.

I have purposely refrained from reducing the whole of the observation results to curves in the above diagrams for the sake of simplicity, and that those of your readers unacquainted with the simple and interesting method of *demonstration by curves* may learn to apply it for themselves.

But upon further and continued investigation, as regards the features already mentioned we meet with a difficulty, for it sometimes happens that the dynamic and directive variations of



the earth current upon different wires for the same time do not agree, the disagreement being at times so great as to almost discredit the conclusions just drawn. Above are given the

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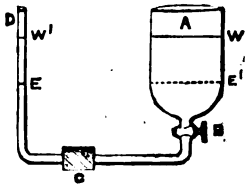
variation curves of three wires (the result of actual experiment), and it will be seen that although the curves agree in contour for some hours, later on they totally disagree. Here, however, I would suggest to the student that it is most unsafe to draw conclusions in regard to earth current phenomena from observations taken upon a limited number of wires, or upon wires radiating only in some directions, instead of to all points, generally, of the compass. To arrive at something definite as to the cause of such disturbances of the general coincidence of curve contour, we must have recourse to our eight wires and examine the above results in connection with their variations for the same time.

(TO BE CONTINUED.)

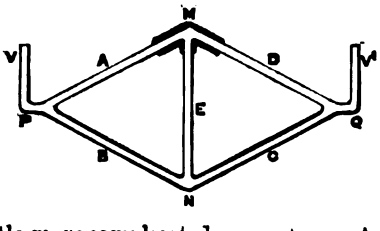
LESSONS FOR LEARNERS.

(CONTINUED FROM PAGE 40.)

I have here a glass vessel, A, partly filled with water. At the bottom of the vessel is a tube with a stop-cock, B. I fix this perforated cork, C, at the end of the tube, and on the other side of the cork insert the small tube D, the top of which is about level with the top of A. On turning the tap, B, the water flows into tube D, but does not go to the top. The water, in fact, stands at the same level in the small tube D, as it does in the large vessel A, both being, as will be seen, open at the top. It may be a surprise to some of you to see that the large quantity of water in A does not push out the water at the top of D. We have here a small column of water balancing a large column. For a very short time after I turned the tap B the water flowed, that is moved through the tube till it reached W^1 a point in the small tube at the same level as W, the top of the water in the larger vessel. When the water reached W^1, motion ceased, and there is now no flowing motion of the water in the apparatus. I will now take away the small column of water which balances the large part. The tube D is out, and you see the water from A is fast getting out also. Now it is all gone.



Let us try once more with a little different arrangement. B is made safe, and I fill up A with water. Instead of a tube reaching as high as D, I use one that reaches to E only, and turning on B we see the water running over at E, till the top of the water in A is at E^1 level with E, when no more runs out. If we try over and over again we shall find that the water in every case will cease its motion when it is at the same level in both vessels, and I may tell you further that, had you a dozen or any number of vessels connected the one with the other, the water would stand at the same level in each. Make the opening of one vessel lower than the top of the water in the others, and immediately a flow of water and an escape takes place.



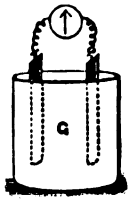
Here is a little more complicated apparatus:—A, B, C, D, and E are all tubes of glass. I use glass so that you may see what passes along the interior. V and V^1 are two upright glass tubes, the others being in a horizontal position. I pour water into V, it quickly fills up the tubing, and runs into V^1. The horizontal tubing is now made as level as possible; that is, P, M, N, and Q are all at the same level. I am, however, more especially concerned that M and N should be exactly level, and I think I have managed it. You see that the water in V and V^1 is at the same level, and that the tubes A, B, C, D, and E are filled with clear water. I will now join the tube V with a small cistern at a higher level by means of an india rubber tube. The cistern is full of coloured water. On turning the tap of the cistern you see the water begins to run out at V^1, the coloured water runs along A and B, along D and C, but it does not seem to go into E. I leave it running a little while, but still there is no coloured water in E; remember, M and N are exactly level. By this I mean exactly the same height above the floor, or, to be still more exact, above the sea level. I raise M ever so slightly, and at once you see the colour rushing along from M to N. I now change the tube to another cistern, containing a differently-coloured water, and raising N above M you see the water going from N to M. Thus, the height of the one point over the other determines the direction of the flow of the liquid.

Let us go back a little. We have seen that the water would not flow unless it could go from a point at a given level to a point at a lower level.

I will take this cork, which fits somewhat loosely into V^1, and put it at the end of the tube. The flow is stopped. I now connect V^1 with a cistern at the top of the house, and you see the cork flies out, followed by a rush of water. This cork fits tighter, and stops the water once more, but connecting V with the cistern at the top of yonder tower, the water sends the cork flying to the ceiling of the room, and follows after. That is, I think, enough to show us that the higher the source of the water—for the cisterns are all the same size, and filled to the same depth—the greater the pressure it exerts. Flow of water, then, is from a higher to a lower level. Flow of heat, I might also show you, is from a point of higher temperature to a point of lower temperature. Flow of steam is from a point of higher pressure to a point of lower pressure.

If you ask why water moves from a high to a low level, you will get the reply, "Because of the action of 'gravitation.'" If you are still inquisitive, and ask what is gravitation? a wise man will answer, "I do not know," an unwise one will perhaps say more, without, however, getting outside the bounds of the unknown.

There is a condition in electricity very much like "height of water" in hydrostatics, or "temperature" in heat, or "pressure" in pneumatics. Just as the height of two points may be the same, or may differ, or the temperature of two bodies may be similar or different, so the electrical condition of two points may be exactly similar or may differ. It is to this difference of electrical condition between two points that we owe the phenomenon of the electric current. We have seen a cork stop the flow of water, but a higher head of water proved too much for the cork; we know that a piece of flannel will stop the flow of heat, but the flannel is set at naught by raising the temperature, and we may remember that a long wire partially stopped the current during the experiments in our first lesson. Let us try and find out a little more about this stopping the current. Here is a cell. Cu



represents a plate of copper, Zn a plate of zinc. The binding screws on the copper and zinc plates respectively are connected with the binding screws of a galvanometer.

The galvanometer indicates a current. There is a difference of electrical condition between the copper plate and the zinc plate. We will put the galvonometer aside for a little. I take the containing vessel G, and place in it at opposite sides the plates of copper and zinc. In a separate thin glass beaker I put 10 parts of water, and then add one part of sulphuric acid. (The chemical symbols for water are H_2O and for sulphuric acid H_2SO_4.) I pour this mixture into G and watch closely. Nothing so far as I can see happens. I join the binding screws of the copper and zinc by a piece of wire, and now the liquid seems turned into a basin at the foot of a miniature Niagara. There is a tornado of bubbles rushing upwards from the zinc plate, and to a smaller extent from the copper. I disconnect the wire and the commotion ceases. I join the plates by means of this long thin piece of wire and the action recommences, but the tornado has ceased, and a gentle rain is going on. If I use the galvanometer, first joining by means of short thick wires, you see the storm again raging, and the needle turns through a large arc. With the long piece of wire put in between the copper and the galvanometer, or between the zinc and the galvanometer the needle does not swing so far. A second long wire put on the other side to connect the screws causes the needle to go still more backward towards zero. On changing the long wires for others still longer and less in diameter the needle refuses to budge, and clings to the zero point. Evidently our cork is now too tight, and if we want it to move we must change the electrical condition that answers to "height of water."

(TO BE CONTINUED.)

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THE INTERNATIONAL CONGRESS OF ELECTRICIANS.

From day to day the French newspapers as well as the periodicals representing the scientific bodies in Paris contain some notice or comment relating to the forthcoming Congress and Exhibition. It is clear that our friends across the Channel are in earnest about these matters, and that it will be no fault of theirs if the undertakings do not succeed. The publication, a few days after the preliminary announcement, of a complete scheme of organisation showed that considerable care and forethought had been bestowed on the subject, and that it was not the sudden or immatured conception of a volatile and fanciful people. Further, the reasons for holding and the objects to be gained by this unique gathering have been set forth in an able paper addressed to the Government by the Minister of Posts and Telegraphs; and our latest information is to the effect that the Chamber of Deputies are, not only heartily co-operating with him, but that they will vote a liberal sum of public money to help him to carry out his scheme on the lines he has laid down.

Nearly two months have elapsed since news of this important project reached England. Yet so far as we can learn not a single step of any definite kind towards joining it has been taken in our own country. No doubt there have been the usual diplomatic intimations and acceptances as provided for in the original scheme. But this may mean anything or nothing; and as the English Government has, with rare exceptions, always taken but a lukewarm interest in science, we are naturally apprehensive that it will not exhibit a livelier sense of its duty on the present occasion. Had the enlightened Prince, the nineteenth annual commemoration of whose death was solemnised at Frogmore during the present week, been still alive, we could certainly have counted on England occupying in any international assembly of this kind the high position to which she has undoubtedly pre-eminent claims. Germany, of course, is already to the front; America, we may be sure, will not let such an opportunity slip without profiting by it, whilst the favour and patronage bestowed upon electrical science in both Russia and Italy render their active co-operation a certainty. England's claims to be conspicuously represented hardly require to be stated. In all that has made electrical science a practical and beneficent servant of mankind, this country has always taken the lead, and maintains it still, though of late years she has been hard pressed by her junior competitors. Nor is she less distinguished for her scientific achievements relating to this class of enterprise, which, indeed, has been planted and sustained by the untiring researches of English electricians. Their written works are the text-books of the world, and though electrical science with us is not so simplified as in France or so popular as in America, it is more trustworthy than in either. With such eminent representatives as Ayrton, Crystal, Cumming, Clark, FitzGerald, Forster, Garnett, Hughes, Jenkin, Lodge, Macfarlane, Perry, Preece, Siemens, Tait, Thomson, Varley, and a host of others whose names at once occur to us in this connection, it would be a waste of modesty to pretend that we cannot hold our own on foreign ground. That some of these English celebrities could be induced to appear at the Congress, not only as visitors, but as the readers of original papers, we make no doubt whatever. But it is obvious that the French Government cannot put itself in communication with them, and induce them to contribute in that way. It can only be done through local organisation; and what has struck us with surprise is that neither from official quarters nor from any of the learned societies do we hear of anything of the kind being in contemplation. Now is the time for combination. We are at the threshold of the new year, and the month of August will speedily overtake us. The occasion demands it, and, indeed, combination is the only mode of adequately meeting the case. The Society of Telegraph Engineers cannot of itself do all that is needed. In the first place, it is not yet a Society of "Electricians," and the same may be said of the Physical and the Chemical Societies. With the Royal Society added, these three bodies could, however, furnish a strong contingent of the class of men that are wanted to honourably represent us in Paris next autumn, and we earnestly trust that steps to ensure the attainment of an object so much to be desired may be taken without any more delay.

As to aid from the Government, we do not know whether it is to be so much as dreamed of. Still, we are of opinion that aid ought to be asked, and that it ought not to be refused. Parliament will soon be sitting, and meanwhile some one, it may be hoped, will make it his business to sound the Postmaster-General as to his views. Thrift and cheap telegrams are intimately mixed up with this subject, and telegraphy has ever been a "peace preservation act" that meets opposition from no quarter. Mr. Fawcett could, doubtless, obtain pecuniary assistance; but, failing that, he can, in any case, lend the ample resources of his department to contribute to the English section of the Exhibition.

As to this latter, private enterprise may be left largely to

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itself for the initiative. But an organisation, either governmental or scientific, will be needed under the provisions of the scheme as we understand it; and even if it were not so, the credit of the nation being at stake it would be highly inexpedient to allow every would-be exhibitor to go his own way. What we advocated for the Exhibition in connection with the Telegraph Conference last year we advocate now—namely a careful preliminary examination of each exhibit, and the clearest description of it that can be usefully put into print. This is the more necessary in a foreign country where many of our quite familiar appliances, past and present, are absolutely unknown. Such descriptions, if thoroughly well done and printed in French and German, would render our handiwork intelligible—and this is all we require to make it appreciated.

SOCIETY OF TELEGRAPH ENGINEERS.

Wednesday, December 8th.

(CONTINUED FROM PAGE 44.)

The meeting which we partially reported in our last was as exceptional in respect to distinguished visitors as it was in point of numbers. Besides the members of the council, who mustered in great force, we noticed Earl Stanhope, Lord Claude Hamilton, Professors Stokes and Tyndall, Warren de la Rue, F. J. Bramwell, Shelford Bidwell, and Messrs. Bidder, Q.C., and Michael, Q.C. Some Celestial notabilities were also present accompanied, as visitors from that region usually are, by Dr. Steel, of the Post Office. A large amount of apparatus was collected for inspection, including that of Mr. Shelford Bidwell, which was in actual work, and attracted attention for a long time after the usual hour for closing the proceedings.

Returning now to Mr. Preece's discourse, Professor Adams had in 1876 discovered that one of the effects of light falling upon selenium was to set up within it an electric current, and Professor Sabine's selenium cell, which was exhibited, confirmed this fact; two pieces of selenium in a dark cell, and connected with a galvanometer, deflected the needle when either of them was momentarily exposed to light. The effect being instantaneous, indicated that light was the cause, and not heat, the effect of which would have been more gradual. Professor Crooke's beautiful experiments were also referred to as showing that the colour of the light determined the effect, for he observed that a radiometer, the discs of which were of selenium on one side and chromic oxide on the other, were differently propelled by white and by yellow flames. Professor Minchin had also experimented with plates of tin foil in hard water, and found that these gave electro-negative effects under exposure to light, changing afterwards to electro-positive. The general result of these experiments with selenium went to show, as Professor Adams had previously asserted, that the alteration of resistance might in part be occasioned by independent currents sometimes assisting the external currents, and that the variable results might be due to the independent currents sometimes opposing the external ones. Moreover, as Professor Adams observed later on, selenium is itself very variable, at one season of the year giving quite different results to those obtained at another season.

At this stage of the researches came the discovery of the telephone, and remembering the properties of selenium, and knowing the extreme sensibility of his instrument, Professor Bell was bold enough to predict that some day we might *hear a shadow*. A few days after this Mr. Willoughby Smith announced that he actually had heard one—that is to say, on obscuring his selenium arrangements, which he caused to be connected with one of Professor Bell's then newly invented telephones, a sound was distinctly heard in it. The last-named gentleman had followed up the subject, and in conjunction with Mr. Sumner Tainter, had constructed a photophone wherewith it was now no exaggeration to say "the blind could hear the light." He had made this a reality, and poets of ancient times who ascribed to Apollo the power of smiting dumb nature into song had now their fancies translated into actual fact.

Professor Bell then rose, and was most enthusiastically received. Mr. Preece having dealt pretty fully with the electrical part of the phenomena, Mr. Bell's remarks were chiefly devoted to the sonorous effects produced in bodies by intermittent light falling upon them directly. He commenced, however, by observing that the original discovery of sunlight effect upon selenium being accidental, it was highly improbable that this metal was the only one, or the only substance similarly susceptible. His surmise had to some extent been borne out by experiments with sulphur, the conductivity of which certainly increases with a rise of temperature; and it was not unlikely that it would prove to be a convenient substitute for the rarer and costlier metal. Professor Bell then proceeded to state that he had been led to his present discoveries by reflecting upon the familiar sonorous effect of intermittent electro-magnetic influence upon iron. He was struck, in the first instance, with the idea of producing sound by the action of light on selenium in this way, and he saw at once that, with the assistance of a telephone, sonorous effects could be produced at the extreme distance at which the metal would respond to the action of a luminous body. By means of the perforated circular plates, a ray of light reflected from a distance was rendered intermittent, and the results were what he had anticipated. But, in order to reproduce vocal sounds, an undulatory impulse had to be given to the light, and this was accomplished by using a flexible mirror of silvered mica, or microscopic glass, as a diaphragm. The perforated plates and mirror have been illustrated in our columns,* so that we need not now describe them in detail; nor is it necessary to say more in reference to this part of the subject than that articulate speech can with these appliances be transmitted to a considerable distance without any intermediary save that which the sun's rays may afford. But an accidental observation during these experiments led to the further discovery that not only could the usual telegraph wire be dispensed with but that the telephonic repeater was also unnecessary. On interposing a piece of hard rubber between the discs and the lens it was found that the sounds were not cut off—invisible rays, indeed, seemed to pass through the substance—and it then occurred to the experimenters to focus the beam of light directly upon the rubber and listen. A distinct musical note was immediately heard. The best effects were obtained by shaping thin rubber into the form of a tube and allowing the rays to fall within it. A great number of substances have since been tried in this way, and with few exceptions audible sounds are found to be produced in them solely by the action of an intermittent ray of light. Perhaps the best effect is obtained upon pine chips collected in a test tube. Some experiments upon vapours of various kinds had recently been made at the Royal Institution, from which it was evident that the effect was due to molecular disturbance.

After some observations by Professor Adams, to which we have referred above,

Professor Tyndall described more in detail the experiments at the Royal Institution, where the electric light had been employed with Professor Bell's apparatus. Being then engaged investigating the effects of radiant heat upon vapours, it occurred to Professor Tyndall to subject them to the intermittent beam of light. Sulphuric ether and bi-sulphide of carbon vapour were thus tested, with results which to him were conclusive that the molecular disturbance resulting in sound was mainly, though perhaps not exclusively, traceable to the heat rays,—was in fact due to the intermittent absorption of heat, for the vapour which absorbed no heat emitted no sound.

Mr. Latimer Clarke, who occupied the chair, then conveyed the hearty vote of thanks of the meeting to Mr. Preece and Professor Bell for their interesting and instructive lectures, and the proceedings terminated.

PHYSICAL SOCIETY.—DEC. 11.

Professor W. G. Adams in the chair.

LUMINOUS PAINT.

Lieut. L. DARWIN read a paper on the rate of loss of light from phosphorescent substances. His experiments were made at Chatham on Balmain's luminous paint by comparing the intensity of the phosphorescent light with the light of a sun burner; the luminous surface being kept cool by placing ice and water near, as a slight increase of temperature in the surface considerably increases the quantity of light given off in a certain space of time. The supply of light was communicated to the paint from a mirror reflecting sunlight. A table and a curve exhibited to the meeting showed the rate of loss found by Lieut. Darwin. It is independent of the original intensity of the illumination. According to the curve the light diminishes very nearly in proportion to the square of the intensity of the light. In a report on the use of Balmain's paint in mines it had been stated that the phosphorescence became brighter a few minutes after exposure in the dark; but the curve showed this to be an error, due probably to the fact that the eye becomes

* *Electrician*, October 2, 1880.

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more sensitive to light after being a few minutes in the dark. Mr. Pearsall emphasised the advantages of such a light in fiery mines. Professor Guthrie enquired if the phosphorescent power grew weaker by time, and Lieut. Darwin instanced a specimen 80 years old to the contrary; but Dr. W. Crookes stated that in sulphuretted hydrogen, and damp air, these luminous substances deteriorated. If sealed in a vacuum they would not. Dr. Crookes remarked that in Balmain's patent it was stated that the phosphorescence died out sooner when exposed in a strong light for a short time than to a weak light for a longer time; but Lieut. Darwin thought this was explained by the slow decrease in the lower part of the curve, when the phosphorescence became faint. Mr. R. I. Lecky mentioned that Evelyn in his diary (1658) describes a phosphorescent powder as "bottling up" sunlight. Dr. Coffin enquired if short exposure to strong light was equivalent to long exposure to feeble light. Lieut. Darwin thought not.

Electromotive Force and Chemical Affinity.

Dr. C. R. Alder Wright read a full paper on the "Determination of Chemical Affinity in Terms of Electromotive Force." He considered, first, the value of the B.A. unit of resistance, which from different experimenters might be taken as really 1·005 earth quadrants per second, or not more than ½ per cent. out. Clark's element, when carefully prepared, was practically correct at 1·457 volts, and it kept constant for three or four months after being made, but deteriorated thenceforth some 3 per cent. in about two years. The deterioration was assisted by air, which could not be well excluded by the paraffin cork, as it cracked. If sealed in the Sprengel vacuum the element lasted better. Joule's mechanical equivalent of heat (J) he estimated at 42×10^6, or not over 1 per cent. greater than Joule's water value. The chief result of Dr. Wright's researches was the conclusion that the action of a current in electrolysis is to decompose the electrolyte into "nascent" products, which evolve heat in changing into ordinary products of electrolysis. These nascent products may be the ultimate atoms composing the molecules of the ordinary products, and the heat is given out in these atoms coming together to produce molecules, say, of oxygen and hydrogen in the case of water. A number of deductions from this theorem are verified by experiment. One of these is that no gas battery can give a higher E. M. F. than 1·5 volts. A result not before published is that the E. M. F. of a Daniell cell is a function of the current, and is a maximum when the current is indefinitely small. The variation may amount to 10 degrees. Therefore, all methods of determining internal resistance of a battery by means of two currents of different strength are inaccurate. Professor Adams enquired if Dr. Wright had seen the letter of Professor Rowland's assistant to the effect that Dr. Wright's former estimate of the ohm was on the wrong side of unity. He had been too busy to see it. Professor Forster thought that the variation of E. M. F. in a cell with the current was to be expected, and was probably due to the slowness of diffusion. Dr. Wright thought diffusion would account for it. Dr. Lodge said there was no way of measuring the resistance of a cell except by employing two currents of different strength, and therefore it was necessary to know the law of variation of E. M. F. with current strength. Dr. Wright stated that he had found two methods of *overcoming the* proceeding with currents of the same strength. With regard to the deduction of Dr. Wright that no current passes without producing electrolysis, Mr. Walenn enquired if the ordinary law of solution held when there was no evolution of hydrogen, and was answered in the affirmative. Professor Guthrie cited the experiments of Mr. C. V. Boys and himself on the conductivity of liquids as an instance of a current passing without electrolysis, or if there was decomposition it was followed by instant recomposition. Dr. Wright thought there must be electrolysis in Dr. Guthrie's experiments (which were conducted by rotating a glass vessel filled with the liquid between the poles of a magnet, after Arago's experiment) because some two parts of the rotating vessel would be at different potentials, and a current would be set up in the liquid.

The society then adjourned till after Christmas, and a paper by Professor Sylvanus Thompson on the photophone had to be postponed.

CABLE-LAYING IN GUIANA.

BY J. MUNRO, C.E.

(CONTINUED FROM PAGE 45.)

A brisk trade is now carried on between Para and the other cities of Brazil; cabs are to be found in its thoroughfares; and a line of steamers ply regularly between its quays and the remote settlements up the river. Para is a curious motley place, where civilisation and savagedom meet and are mingled, where the virgin forest runs into the city square, where the European, the Indian, and the negro races blend indiscriminately, and where the most wretched human squalor and vileness are everywhere surrounded by the indescribable beauty and luxuriance of nature.

But Para is the cradle of a new race, perhaps of a new civilisation, and it is destined, by its unrivalled site, to be a great metropolis in the future. Let us pay it a visit.

We leave the "Hooper" in the steam launch before sunrise, and steer close in shore past the swelling shrubbery, overtopped with feathery palms. The tender yellow glow of a tropical sunrise overspreads the eastern horizon. The cool morning air is fresh and sweet; the glassy river is perfectly still, and gilded by the pale alchemy of the sunrise. Occasionally the strange cry of a bird echoes through the sleeping forest, and there is a damp grassy smell rising off the woods and lawns. We shoot silently by pretty coves in the spreading mangrove thickets which fringe the shore, protected by armies of broad-leaved arums and tall grasses. These are the mouths of *igaripés* or creeks, whose dark coffee coloured waters vanish in the wall of shrubbery and palms. A scarlet ibis stands on stilted leg upon the mud of the bank in striking contrast with the dull green jungle behind it. Very inviting are these watery paths leading into this magnificent natural garden. The city of Para is gleaming in the morning sun; and swimming in a veil of silvery mist; the river islands are just kindling in the early rays of the sun. Canoes of Indians and negroes, rapidly urged by short paddles, glide upstream under the black shadow of the forest. They move so stealthily that it is easy to fancy them to be savages on the war path, whereas they are only honest squatters or slaves eager to get to Para with fruit and vegetables for the morning market.

The quays and harbour of the city are crowded with all kinds of craft, and folk of all imaginable shades, from the pure white Teutonic creole to the pitch-black Congo negro. There are the large *montarias*, or lighters of riverside planters, laden with sheaves of sugar cane, piles of Brazil nuts, and lumps of caoutchouc. The planter is lazily smoking a cigarette in a grass hammock under an awning of palm leaves, while his half-naked slaves steer the boat into position alongside the wharf. Some of these montarias are very large, and make long river voyages. In another of them we see an entire Indian family quartered under the palm-thatch, sleeping, cooking, and eating, like gipsies in a caravan. Between the montarias are hundreds of smaller canoes, full of the semi-savage produce of the country. There are Indians with ibis or tiger skins, live snakes, monkeys, and parrots for sale, bunches of herbs, and medicinal barks: negroes with painted calabashes, long stemmed pipes, pumpkins, and gaudy tropical fruits. Along the pier and in the market place there is the greatest activity and babble, for the market is, next to the festa or holiday, the chief event of Paraense existence, and this happens to be the market of a festa day. Large negresses and brown Indian women in clean white chemises—their only garment—are squatted about on the ground, beside wooden trays full of bananas and farinha bread, some puffing at long Indian pipes, others supping *assai*, a peculiar potage made from the assai-palm, out of a painted calabash. They sit expressionless, careless whether you buy or not, for touting does not exist under these indolent skies. Nevertheless, a great deal of business is done. The market is packed with roots and vegetables, luscious pineapples, whorls of ripe plantains, curious nuts and mats, withies of sepaw vine, sandy turtle eggs, pails of wild beef from the great island of Marajo across the river, and bundles of *periecu*, or dried fish. Besides these staples there are many curious nick-nacks and Amazonian articles of *vertu*, such as snake vertebræ for necklaces, glass beads, fish-tongue scrapers, carved cocoa-nuts, Indian blow-pipes, and cheap Brummagem cutlery. Here, too, can be purchased splendid red and green parrots, toucans, turtles, raccoons, and monkeys. Most of the marketing is done by the poorer Europeans and the coloured population, but here and there one may see some fine Brazilian lady in Lyons silks perambulating the stalls, escorted by her husband.

Except to the traveller there is little to be seen that is interesting in Para. The streets are, as a rule, unpaved and full of ruts, half filled with sand. The houses are low and plain, tinted with coloured ochres, rose, blue, and yellow, the latticed windows being open to the warm air. There is a deserted, lifeless appearance about the dusty, dilapidated town. If we look along an ordinary thoroughfare we generally see a swart, dapper, Brazilian merchant, with a Chilian straw hat and an umbrella to shade him from the sun; a sluggish negress, waddling along with a naked baby astride on her hip; a black-browed priest; a brown Tapuya woman, carrying a clay water jar or *bilha* poised on her head, and a brawny negro, in a palm-leaf hat and striped cotton trousers, shouldering a hoe, or trundling a wheelbarrow, with the sunlight glistening on his oily skin and supple limbs. The shops are open stores full of all kinds of groceries and gay Manchester goods, including bright cotton hammocks and mosquito nets. There is no system of cleansing and drainage in the place beyond what is effected by unofficial turkey-buzzards and gratuitous showers of rain, so that the open gutters are not always as clean and sweet as might be desired by a conscientious sanitary inspector.

As we leave the heart of the town with its markets, custom-house, and wharves, the streets grow even more abandoned looking, and we come upon some neglected convent, Carmelite or Jesuit, whose bell is rusted on the crumbling towers, and whose yard is grass-grown. Here a group of pot-bellied children of all shades are squatted in the dust without any garment but the dirt they have accumulated. One of these is a tall white girl of seven, with brown hair and eyes of a beautiful dreamy blue. Poor children in Para are not much inconvenienced by the artificialities of civilised life. The moist, warm air, is their only clothing, the Church is profoundly indifferent to them, and there are as yet no school boards to molest them.

Like every other American city Para has its restaurant, where cocktails and other iced drinks can be obtained. This is kept by a shrewd but honest Portuguese, familiarly styled "Joe." Portuguese Joe's store is an *omnium gatherum* of the whole commerce of the country. If you want a rattlesnake or a lively young tiger-cat, go to Portuguese Joe, or if you want Mr. Gladstone's last pamphlet, Peak and Freen's biscuits, or Bass's ale, go to Portuguese Joe. His shelves are stored with Indian spears, feather dresses, preserved meats, wines, firearms, medicines, and provisions of all kinds. At the moment of our visit to Joe's to get a glass of bitters before breakfasting at the Hotel do Commercio, a group of Yankees, of fillibustering aspect, are seated at a rude table playing "poker" with a dirty pack o Spanish cards. From Portuguese Joe's to the Hotel do Commercio is only a few steps across the *largo*, or public square. On the way we meet a

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tall, but still powerful old man, in a grey tweed suit evidently fashioned twenty years ago. This is "old Henderson," a Scotchman, and perhaps the best known character in Para, a man who has been forty years in the city, and came through the revolution. He has known all the naturalists who have visited the river, from Edwards to Agaziz, and has many curious experiences to relate, when sitting in his store with a glass of good Glenlivet at his elbow. I give his account of the death of brave Captain Inglis in the revolution of 1835 as he told it to me. Inglis was a captain in the Brazilian navy, his ship being stationed at Para. When the revolution broke out he was on shore, and hearing the firing, he rushed along the street with his naked sword in his hand to see what was the meaning of the tumult. "He was the bravest fellow I ever clapped eyes on," said the old Scotchman, as he sprang to his feet with enthusiasm, "he just ran straight at the rebels, and shot the first in the face. Then he drove his sword right through another to the hilt; but could not withdraw it. By this time they had surrounded him; a ball broke one wrist, another broke his other arm, and a third lodged in his body. He fell, and they speared him in the back, and further shot at him, and otherwise maltreated him, to make sure that he was really dead. But Inglis never winced. They carried him to my store here, pitched him n, and left him. As soon as they were gone, he sat up with a smile on his face and called for rum and water and the ship's surgeon. He was quite cheerful, though he had but a few minutes to live, and never uttered a single complaint. He made his will, and consigned a glass case full of stuffed birds to his sweetheart Emily Roy, in Edinburgh, and then gave up his 'gallant ghost' without a sigh. Many years after," continued old Henderson, "I was travelling by stage coach from Kinross along with two lady passengers, and on entering into conversation with them, I found them to be relations of Captain Inglis and Miss Roy. 'It's a fine day ladies,' I said, 'almost as warm as in Para, when I left it.' 'Oh, have you come from Para,' said they; 'we knew a Captain Inglis who died there.' 'I received his last breath,' said I."

The Hotel do Commercio of Para is the principal hotel in the place, and overlooks the port and the river, with its buzzard-haunted mud flats, its green islands, and scarlet Amazon steamers. The bed rooms are fitted up with hammocks and mosquito curtains, and the bare-walled dining saloon is set with tables covered with snowy cloth. A French *menu* lies on each, and you are served by Dutch or German waiters. A considerable variety of nationalities are represented at its boards. Besides ourselves from the English telegraph ship, there are Italian opera singers on their way to Monte Video, Peruvian merchants from Quito across the Andes, commercial men from Pernambuco and Rio Janeiro, and there are also, we are told, a Yankee naturalist just returned from exploring the Madeira River, a Cinchona merchant from Bolivia, and a somewhat shabby remnant of the "Southern chivalry," now acting as a Portuguese interpreter. After a *ragout aupommes*, followed by cheese and bananas, we can loll in rocking chairs by the open windows, enjoying the after-breakfast coffee and cigars and the cooling breeze up the river, then stroll out into the streets again in time to go to church and see the procession which is the principal event of the festa. The interior of these Portuguese cathedrals is very gorgeous, but somewhat tawdry and vulgar. The image of the Virgin is usually a handsome wax doll, dressed in silver tinsel and bright-coloured silks. The floor of the church is strewn with citron leaves, and the air is heavy with incense. The worshippers are without exception females, and chiefly Indian women and negresses, the former in their snow-white chemises, with dark expressive eyes and long black hair, in which a wreath of white jessamine is twined, and the latter with their gaudier prints and heavy golden bangles, making a very picturesque group as they kneel on the floor in front of the altar. A procession of pretty little Portuguese maidens, mostly in snow-white dresses and coloured sashes, and with myrtle wreaths or silver crowns upon their heads, enter up the centre aisle. Some of these girls are very beautiful, of a calm and classic type, as beautiful as the angels they are intended to symbolise; but though the incense, music, and the imposing spectacle are all calculated to impress the imagination, there are one or two drawbacks which cannot escape the sight. It is too evident that the gentlemen in the side aisles and the fine ladies in the galleries have congregated to see the show; the holy water with which everyone crosses the forehead is not over clean, and mangy dogs are somewhat out of place in church.

When the priestly ceremonies before the altar are ended, a procession is formed of the maidens in white, headed by the "host," the cross, and a number of candle-bearers. It leaves the cathedral amidst the tolling of bells, and the crackling of rockets fired in the broad day, and parades the streets, now crowded with the motley population, to the music of a barefooted negro band.

While we remained at Para we electricians made several excursions beyond the town itself into the surrounding woods. One day we paid a visit to the *seringal* or india rubber grove west of the city. The suburbs of Para are simply palm thatched Indian huts of wattle and clay half buried by the luxuriant shrubbery which verges the forest. They are inhabited by the poorer Tapuya, negro, mulatto, mameluke, and Cafuzo people. The Tapuyas are the pure blooded native Indians, who were always a gentle people, and are now civilised; the mamelukes are the offspring of Indian and white parents; the Cafuzo those of Indian and negro parents. They live peaceably together an indolent, sensuous existence, veritable children of nature, cultivating the manioc or cassava for its flour, fishing in the creeks of the river, shooting in the woods, and gathering the india rubber in its season; while bounteous nature supplies them all the year with her fruits,—bananas, oranges, pines, and mangoes.

The way to the seringal takes us past the Estrada das Mongubeiras, once the broadway of Para, an avenue of silk cotton trees and stately palmists or cabbage palms; but it is now traversed by a tramway and its appearance quite neglected. Para possesses an arsenal here, but the only symptom of bellicose preparations that we can see is a rusted cannon lying among some tall grass. A black sentry in a shabby blue and white uniform stands at the gate in the overpowering heat, sound asleep on his feet. As we pass by, his rifle with its naked bayonet falls from his hands and rattles on the stony ground, startling him sluggishly from his trance. Without even looking at us he lazily picks it up and goes to sleep again. Beyond the arsenal the trail leads us past some Indian sheds with their farinha plots hemmed in by dilapidated grey palings. The rude pottery of the open kitchen, the ill-fed poultry scratching in the dry earth, the hogs running about at large, and the ricketty fences, are in forcible contrast with the dark green foliage of the mango trees, the golden fruited oranges, the lustrous crested palms on every side, and the flowering parasites which cling to the tumble-down erection, as if Nature wished to conceal these unsightly evidences of human neglect. We cross a waste space overgrown with rank grasses, acacias, and convolvuli, and glittering under the stifling sun; then enter into the wood, a tree fern jungle, with butterflies darting among the shaggy trunks, brilliant humming birds fluttering over some startling flower, and a piercing chorus of crickets in the dewy tops of the palms. Then we pass through a dense thicket bound together with sepaws, into a cool grove of cacao trees, whose yellow fruits are hanging like gourds from the limbs. Beyond this we creep under a dark passage, among arching palms, wading among a deep litter of cast off vegetation rotting in the damp of the perpetual shade—a fit haunt for snakes. Working our way through this without knowing what the next step will bring us to, we suddenly emerge upon the banks of a sunlit creek. The brown tide, illuminated with broad flecks of light, glides silently past, its surface stirred only by the gilded wing of a passing dragon fly. An army of tall arums with creamy flowers throng its margin; tree ferns curve their feathery crowns gracefully overhead, and shade away the fierce sun. Leafy cacao trees bend over and droop into the water. Long creepers trail from the forest trees on either bank, and dip their freight of gorgeous blossoms in midstream, uniting both banks, and making a bower overhead. In this charming spot, at a point where an old mango tree leaned its trunk over the creek, a group of young Paraense girls are bathing. They hang their light dresses on the tree and dive from the trunk into the tepid water where they disport themselves like tawny naïads, laughing, chasing, and pelting one another with the woodbine which hangs from the tree tops above and drags its yellow flowers in the water.

We cross the creek on a rude wooden bridge, and enter the seringal, which is simply a rather low-lying portion of the forest, tenanted by india rubber trees. Caoutchouc is one of the principal exports of Para. The *siphônia elastica* or rubber tree grows wild in the neighbouring forests, especially in the marshy parts. It is a straight, tall, handsome tree, with a brown bark, and dark-green, glossy leaves. During the dry season, from June to December, the Tapuya Indians go in parties into the woods to tap the juice of the trees and do their rubber harvesting. Being now the beginning of June, the rubber-collecting had just begun. All through the seringal foot-paths are cut through the dense undergrowth from each seringa tree to the next, and the Tapuya, going his rounds, bores a hole into the bark of each tree, a few feet from the ground. The creamy juice at once begins to exude, and a cup of moist clay is stuck to the trunk to collect it as it trickles out. The juice is collected, before it solidifies, into a bamboo stoup, and the Tapuya then takes it to his camp, where the process of curing the rubber is being carried on by his squaw.

(TO BE CONTINUED.)

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Dec. 15.		Business Done Week Ending Dec. 15. Highest.	Lowest.
Anglo-American Ordinary	62¼,	⅜	64¼	62⅛
Do. "B"	92½,	⅝	94	92⅜
Do. "A"	33½,	¾	35⅛	34
Brazilian	9 15-16,	10 1-16	10	9⅛
Cuba	8¾,	9⅛	9	8⅛
Do. Ten per Cent. Pref.	16½,	¾	—	—
Direct Spanish	2⅞,	3⅛	—	—
Do. Ten per Cent. Preference	12½,	¾	12⅜	12⅜
Direct United States	11⅜,	½	12⅛	11⅛
Eastern	9⅞,	⅛	9⅞	9⅝
Do. Six per Cent. Debenture	102,	104	103½	102
Do. Five per Ct. do. 1899	104,	107	—	—
Do. Six p Ct. Pref	12⅜,	13	13	12⅜
Eastern Extension	10 1-16,	3-16	10⅛	10
Do. Six per Ct. Deb	108,	111	111	111
German Union	10,	¼	—	—
Globe Telegraph & Trust	6⅞,	⅛	7	6 13-16
Do. Six p Ct. Preference	12 1-16,	3-16	12⅜	12⅜
Great Northern	11,	¼	11⅜	11
Indo-European	25,	26	—	—
Mediterranean Extension	2⅜,	3⅛	3⅛	3
Do. Eight p Cent. Pref	10⅜,	11⅛	—	—
Reuter's	10⅜,	11⅛	11	11
Submarine	260,	270	262	260
West India and Panama	2⅛,	⅛	2⅜	2 1-16
Do. Six per Cent. 1st Preference	7	¼	7⅛	13-16
Western and Brazilian	9⅛,	⅜	9⅛	8⅛
West. Union 7 p. Ct. 1st Mt.	120,	125	123	123
Do. Six per Ct. Sterg.	104,	107	—	—

TRAFFIC RECEIPTS FOR NOVEMBER, 1880.

Companies.	Nov., 1880.	Nov., 1879.	Increase.	Decrease.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	1,900 estd.	3,110	—	1,210
Direct United States Telegraph Company	—	—	—	—
Direct Spanish Telegraph Company	1,465	1,334	131	—
Eastern Telegraph Company	47,669	46,147	1,522	—
Eastern Extension Telegraph Company	29,724	26,379	3,345	—
Great Northern Telegraph Company	20,800	—	—	—

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ABSTRACTS OF SPECIFICATIONS.

—o—

We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts—ED. *E.*]

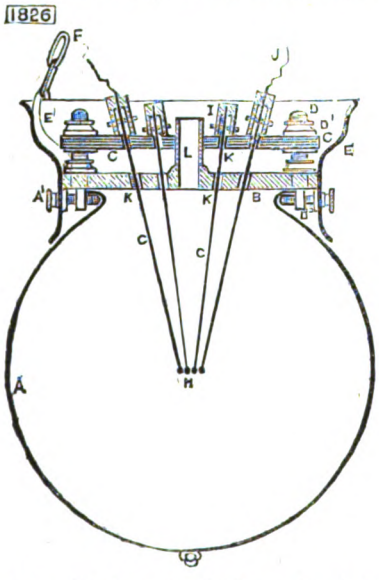
1820. ELECTRICAL SIGNALLING ON RAILWAYS, *H. J. Allison.—Dated 4th May*, 1880.—(*A communication.*)—(*Not proceeded* with.) 2*d.*

A telegraphic wire connects the two stations, and at each extremity of the wire is an electric apparatus composed of an electro-magnet and a soft iron bar or armature, which apparatus is situated between the extremities of the wire connecting the two stations, and of a wire connected with a disc. This disc carries on one side a pivotted bar which is maintained on the red side of the disc by a spring. A strong spring works the rod carrying the disc, which spring is held by a catch, raised at the proper moment by a very strong electro-magnet. A chain connects the disc with a lever situated perpendicularly between the two rails, where it is maintained by two springs. This lever is fixed to a transmission bar, which carries at its extremity an angle piece, which serves during the passage of a train to put the wire of the battery in contact with the wire connecting the two stations.

1826. IMPROVEMENTS IN APPARATUS FOR PRODUCING ELECTRIC LIGHT.—*By James Edward Henry Gordon.—Dated May 4th*, 1880.—*Price* 6*d.*

This invention has for its object improvements in apparatus for producing electric light. For this purpose the lamps are constructed of lumps or knobs of refractory metal fixed on thin stems of the same. Rapidly alternating currents of high intensity are made to discharge from one lump to another, and the lumps which are thereby heated glow and give the light. The thin stems prevent the heat being conducted away too rapidly. The following form of the lamp has been found to be the most advantageous, but is not the only useful form:—Four pear-shaped knobs, each carried by a wire stem, are placed in a line near together, and the two outside ones connected to the conductors supplying the currents. When the discharge passes the two outer knobs get moderately hot and the two inner ones

1826



very hot. The two outer knobs may be platinum and the two inner ones irridium or irridio-platinum alloy. The size of the knob varies according to the strength of the current from about that of a pin's head to that of a small pea. It is generally advantageous to make all four knobs of irridium, and to make the two outer ones smaller than the inner ones. The stems are preferably of platinum or platinum irridium alloy, and I use wires about 2 to 3 inches long or more and about ·06 inch thick, the object being to have them the thinnest which will be safe from melting. The distance apart of the knobs when cold should be such that they just do not touch when expanded by heat. Although four knobs are commonly used, 2, 3, or more than 4 may be used in some cases. The drawing shows a section of the lamp. A is a glass globe held by screws, A^1, to the underside of a plate, B, of glass or porcelain; C is a plate of ebonite carried by brass pillars, D, from the plate B; D^1 are nuts screwing on to the pillars D and holding the plates; D^2 is a crosshead on the lower end of each pillar; the screws A^1 screw through these heads; E is an opaque shade by which the plates B and C may be surrounded; E^1 are arms fixed to the plate B; by these arms the lamp can be suspended by chains F, as shown; G are four stems of platinum wire with knobs, H, of irridium on their lower ends. The upper ends of the wire stems are fixed to the caps or solid tops of tubes I, which are carried by the ebonite plate C. The two outermost wire stems are coupled by wires, J, to the source of the rapidly-alternating currents of electricity. Through the sides of each of the tubes I are screwed three adjusting screws; the ends of the screws bear against the wire stems, and by means of them the knobs at the lower ends of the stems can be held and retained at any required distance apart from one another. There are holes, K, in the plates B and C, through which the wire stems G pass. These holes also serve to admit currents of cool air to the interior of the globe A; L is a chimney by which heated air can rise up and escape from the globe. It is found that much greater tension is required to light the lamps, *i.e.*, to cause the spark to spring between the cold knobs, than to maintain them when lighted. Now, although it is perfectly possible to produce a current of sufficiently high tension either by a machine or by an induction coil to light the lamps, yet it is found that as every increase of tension throws an extra strain on the insulation it is advantageous to bring the four knobs into contact, or nearly into contact, before the lamp is lighted, and to separate them after the current has begun to pass. This may either be done by hand, by the use of suitable levers, or automatically by a lever or levers acted on by the passage of the electric current, or by the heat generated by it or otherwise. Alternating currents of sufficiently high intensity for being used with the lamp may be obtained by the use of induction coils, excited by a De Meritens or other magneto electric or dynamo electric machine giving alternating currents. No contact breaker or primary condensor is required. The machine should be one that gives rapid and sharp reversals. A separate induction coil may be used for each lamp, or several lamps can be placed on one coil as follows:—(1). They may be all placed in series. (2). A better plan is to let each lamp have its own section of the secondary wire. This latter plan makes all the lamps in a coil nearly independent of each other. The lamps may be lighted and extinguished either by a make and break key in the secondary circuit or by short circuiting the secondary. Or the lamps may be lighted and extinguished by shunting the primary current on and off the coil, or on and off several coils at once, with or without the introduction of a compensating resistance. To give some idea of the dimensions of the coils details are given of one which has been used for one 100 candle-light or two 50 candle-lights. The primary consists of a bundle of iron wires 1·3in. diameter and 18in. long. Three layers of insulated wire ·08in. in diameter are wound on it. The secondary is wound on an insulating tube, and consists of about two thirds of a mile of wire ·0075in. diameter covered four times with silk. It is wound in sixty discs. The external diameter of the secondary coil is about 3·5in. There are three binding screws, one at each end and one in the centre, so that the whole coil can be used for one lamp or either half separately. A separate circuit is commonly used for each lamp, the lamp being connected to one or more coils of the machine. The new light is considered to have the following special advantages:—The light is capable of great subdivision. There is no vacuum and no clockwork. The light is extremely steady. he claims are (1) the combined apparatus, machine, induction coil, and lamp. (2) The use in combination for the production of electric light of a magneto electric or dynamo electric machine and a lamp containing lumps of refractory metal carried upon thin stems.

1828. IMPROVEMENTS IN CONTROLLING CLOCKS BY PNEUMATIC PRESSURE AND ELECTRICITY.—*W. R. Lake.—Dated 4th May*, 1880.—(*A communiation.*) 8*d.*

Usually for controlling a number of clocks from a common centre a reservoir and distributing mechanism are wanted. In this invention improved mechanism is used. A reservoir communicating with regulating pressure gauges is used. The clock to be regulated is actuated by compressed air coming from main into cylinder D, Fig. 1, where it acts on a piston, or the cylinder may serve as a guide. The piston acts on lever E carrying pawl F, which gears with ratchet wheel of sixty teeth, G. Each time air enters cylinder G advances one tooth, and as minute hand is geared to it a corresponding movement is made. A balance slide valve is used in the distribution of the compressed air. The electrical controlling device is shown. R is a glass vessel into which the glass tube S extends. R contains mercury, and communicates with the air in the pipes by the valve T and tube U. The pressure on the mercury

1828 FIG. 1.

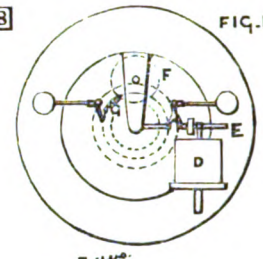


FIG. 2.

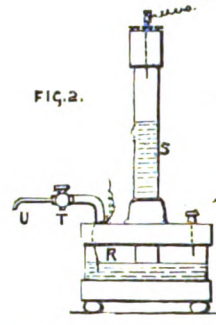
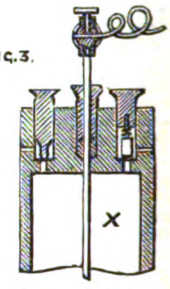


FIG. 3.



causes it to rise or allows its fall, and the condition of the apparatus is known by the different electrical contacts made and signals thereby given. The battery connections are shown. Fig. 3 is a section of the cap in Fig. 2. X is a platinum which as the mercury rises in S may make contact with the mercury. Screw plugs are used to regulate the air inlet. The flow is thus regulated per minute, its rise corresponding to the air pressure from the reservoir, its fall to the escape of the compressed air.

1840. PRODUCTION OF ELECTRIC LIGHT. *W. R. Lake.—Dated 5th May*, 1880.—(*A communication.*) 6*d.*

The inventor uses an oval mass composed of oxide of zirconia or mixture of zirconia and carbon, zirconia and alumina, magnesia, lime, silica, &c. Zirconia is the most infusable substance known, and is also a non-conductor of electricity. Its want of conducting quality renders it incandescent under the electric current when the latter is made to traverse it. Plumbago and other forms of carbon are, next to the metals, the best conductors, but are combustible under high degrees of heat. When a mixture is made the carbon gives conducting power to the electricity, while the surrounding zirconia protects it from contact with the air. The carbon as well as the zirconia will thus be rendered incandescent. The outer coating of zirconia or other substance assists in more completely excluding the air from the carbon. The

1840

FIG. 1

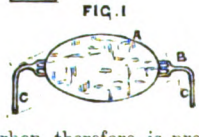
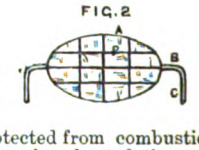


FIG. 2



carbon, therefore, is protected from combustion, and it and zirconia being when heated the most highly incandescent substances produce the best light. The size of the mass to be employed will influence the proportion of the several mixtures. The incandescence and light in the use of this invention are produced by passing electricity through and over the zirconia mass, and at the same time the carbon is protected from contact with the air, and consequently from combustion, so that no mechanism is necessary for feeding the carbon to supply waste. Contact is made by means of platinum holders as shown in the diagram. The oval mass is sometimes perforated by air passages. The claims are (1) the material, and (2) the mode of making contact. A shows oval mass, B platinum connections, C wires, P air passages.

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THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION (Limited).

Registered under the Companies' Acts, 1862—1880.
74, HATTON GARDEN, E.C.; AND VICTORIA WORKS, LAMBETH.
Capital £800,000, in 80,000 shares of £10 each. First Issue, £400,000.

Directors.

*Sir HENRY W. TYLER, M.P., Chairman, Pymmes Park, Edmonton.
*JOHN SCUDAMORE SELLON, Esq. (of Messrs. Johnson, Matthey, and Co.), Vice-Chairman, The Hall, Sydenham.
*Major JAMES CHILDS, Clapham Common.
*WILLIAM LADD, Esq., F.R.A.S. (Electrician), Beak-street, W.
*FREDERICK NETTLEFOLD, Esq. (Messrs. Nettlefold and Sons, London and Birmingham), Streatham Grove, Norwood, S.E.
*Colonel FREDERICK G. STEUART, 14, St. James's-square, S.W.
WILLIAM MUNTON BULLIVANT, Esq., 72, Mark-lane, E.C.
JOHN IRVING COURTENAY, Esq., Plowden Buildings, Temple.
THOMAS J. MONTGOMERY, Esq. (of the Brush Electric Light Co., U.S.), Richmond, Surrey.

(With power to add to their number.)

*Directors of the Anglo-American Electric Light Company, Limited.
Solicitors.—Messrs. RENSHAW AND RENSHAW, 2, Suffolk-lane, Cannon-street, London, E.C.
Secretary.—FRITZ CUNLIFFE-OWEN, Esq.
Brokers.—Messrs. FOSTER AND BRAITHWAITE, 27, Austin Friars, E.C.
Bankers.—Messrs. FULLER, BANBURY, NIX, & MATHIESON, 77, Lombard-street, E.C.

PROSPECTUS ABRIDGED.

The Anglo-American Electric Light Corporation, Limited (hereinafter called the Corporation), is formed for the purpose of taking over the business, and extending the operations of the Anglo-American Electric Light Company, Limited (hereinafter called the Company), which was established mainly with a view of introducing into England the "Brush" system of Electric-lighting.

The Corporation embraces in its patents and contracts, Dynamo-machines, Lamps and Carbons, forming the complete system of Electric-lighting known as the "Brush" system, which has been tested and adopted by various departments of the Government and others (see following list).

In America, the "Brush" system has made great and rapid progress, and has been adopted in Iron and Steel Works, Rolling Mills, Paper Mills, Machine Shops, —Woollen, Cotton, Linen, and Silk Factories, Printing Establishments, Colleges, Hotels, Mines, Smelting Works, River and Ocean Steamers, Parks, &c., &c. According to a cablegram just received from the "Brush" Co., Cleveland, Ohio, U.S., 3,300 have been sold there during the last year.

A suitable and extensive factory has been leased and established in Lambeth, near the Waterloo Bridge and the Charing Cross Stations, and fitted with machinery manufactured by some of the best English and American engineering firms; a large supply of Dynamo machines and of lamps is in course of construction; and the buildings will allow of considerable extension of manufacturing facilities from time to time.

The terms upon which the Company transfer their undertaking to the Corporation are as follows, viz.:—

The Corporation to pay to the Company £100,000 in cash, and £100,000 in fully paid up shares, for the whole of the patents for the United Kingdom, India, the Australias, New Zealand, and the Cape of Good Hope, and their agreement for similar rights for France, Austro-Hungary, Italy, Spain, Belgium, and Sweden, as well as those which have been applied for in Russia, Denmark, and Norway. The above purchase-price includes, further, the valuable goodwill, and the plant, stock, contracts, and liabilities of the Company, with the advantages of a running factory, an established connection, and an organised staff. The orders in hand and those partly executed will be handed over to the Corporation, which will be in a position at once to carry on business on an extensive scale.

The profits of the Corporation will arise from (1) the manufacture and sale of Dynamo-machines and Lamps, and the sale of Carbons; (2) the sale of Continental, Colonial, and other patent-rights; (3) the letting out of lights worked from central positions; (4) contracts with Corporations and other public bodies, and with private firms and individuals. The supply of only one hundred 16-light machines with lamps complete at tariff prices may be estimated of itself to yield a substantial dividend on the present issue of £400,000, even if fully paid up. The sale of carbons will be an ever increasing source of revenue, as the system becomes more widely extended. As regards foreign and colonial patents, it is probable that large amounts will be realised from their sale, separately, as opportunity offers. And the business of letting out lights worked by engines in various central situations, and of contracts with public bodies, firms, and individuals, may fairly be expected to be highly remunerative.

By the "Brush" system any number of lights from 1 to 40, each of 2,000 candle-power; or any number from 1 to 12, each of 6,000 candle-power, or a single light of 50,000 or more candle-power can be produced from one Dynamo-machine. The connecting wires may be extended over circuits of many miles; and it is claimed that economy, constancy, and simplicity are secured at a cost less than by any other system. The Corporation will, however, be at liberty to acquire, sell, and employ any other machines, lamps, or apparatus that may hereafter be found suitable for special or general purposes.

Applications for Shares should be made on the form accompanying the prospectus. £1 to be paid on application, and £3 on allotment. It is not at present intended to call up any further capital, and for any call one month's notice will be given.

In the event of no allotment being made the deposit will be returned in full.

All applications for prospectuses should be addressed to the brokers or the solicitors of the Corporation, or to the secretary, 74, Hatton Garden, London, E.C.

The following lights are in use or have recently been ordered in Great Britain:—

16	Lights—	the Admiralty.
16	,,	South Kensington Museum.
16	,,	Royal School of Mines, Jermyn-street.
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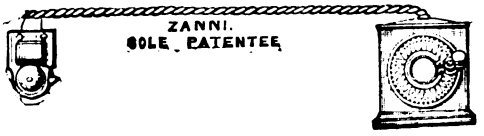

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SLIP

DUMBARTON.—Messrs. Denny and Co. have resolved to light their new and extensive boiler shed by means of the electric light.

ROTARY ENGINES.—Messrs. Siemens have been testing at their works Hodson's rotary engine for driving electric light apparatus, and the results have been uniformly good.

THE NEW FRENCH CABLE.—The new French cable, which was fractured several weeks ago off Cape Cod, has been repaired, and communication with New York has been resumed *viâ* that line.

GREAT INDIAN PENINSULA RAILWAY COMPANY.—The telegraph receipts for the half year ending June 30th, 1879, amounted to £2,488, whilst the amount for the corresponding half year in 1880 was £2,453, or £35 less.

OUDE AND ROHILKUND RAILWAY.—The report submitted at the meeting on December 15 shows that owing to the depression of trade caused by failure of the crops, &c., the telegraph receipts were £110 less than during the corresponding period of 1879.

THE LONTIN ELECTRIC LIGHT.—The Eastern of France Railway station has been lit up by the electric light on the Lontin system, which after trial in the goods station has also been adopted in the passenger station of the Lyons and Mediterranean Company.

THE STATISTICAL SOCIETY.—An excellent paper on the question of the Reduction of the Present Postal Telegraph Traffic, was read on Tuesday last to the members of this society by R. Price Williams, M. Inst. C. E. We shall give an abstract of the arguments in our next issue.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY.—The Board of this Company state that in consequence of the continuance of the war between Chili and Peru they are obliged to defer payment of the coupons on the debentures of the Company, due on the 31st of December next.

THE PARIS EXHIBITION.—We have received from the Ministère des Postes et des Télégraphes the official documents in relation to this exhibition, an abstract of which is being prepared. Any reader who desires a copy of the "General Rules" can have one on application, so far as the number of copies forwarded to us will permit.

THE BRUSH ELECTRIC LIGHT.—The clock face of the clock tower of the Houses of Parliament facing towards Charing Cross has been lately lighted by the Brush electric light, and the contrast with the face looking towards Great George-street, which is still lit by gas, is very striking. The electric-lit face has a bright silvery white appearance, whilst the gas-lit face has a dark dingy red tinge. The first night of the electric lighting the contrast was still more striking, and we strongly suspect that more gas has been turned on or the gas-burners altered since the electric light was first employed.

THE GOWER-BELL TELEPHONE.—"An interesting telephonic feat was on the 16th December performed with the Gower-Bell loud speaking telephone, erected in the telegraph office of the London and South Western Railway Station, presided over by the superintendent of the department, Mr. Rolls. The telephone was successfully tried between Exeter and Yeovil Station, a distance of forty-nine miles, with perfect success. Conversation was maintained, accompanied with laughter and whistling, between the two places with much facility and satisfactory distinctness."—*Exeter and Plymouth Gazette.*

THE POST OFFICE AND TELEPHONY.—With reference to the decision pronounced in the Exchequer Division in the Telephone case, it will be seen from public advertisements that, in order to meet the convenience of the public, the Post Office is now prepared to establish in any town a system of intercommunication by means of the telephone instrument, as it has done hitherto, for some years, by means of the A B C instrument. At the same time, the Post Office holds itself ready to make arrangements for the establishment or continuance of systems of intercommunication between any number of private individuals or firms.

THE ANGLO-AMERICAN TELEGRAPH COMPANY.—It is announced by the Anglo-American Telegraph Company that the steamship "Scotia," which left London on the 18th ult., to raise and repair the Brest cable (1869), broken on the 12th of November last, has put into Plymouth for orders. The Telegraph Construction and Maintenance Company's engineer reports that after picking up the eastern end of the cable 220 miles from Brest the weather became too boisterous to permit the expectation that further operations could be continued during the winter with any reasonable prospect of success. Under the circumstances the directors have decided to postpone the repair until next spring.

THE 1871 MARSEILLES-ALGIERS CABLE.—The French Government have been attempting the repair of a fault of insulation in this cable. The Government have a well-fitted steam vessel, named the "Charente," for cable repairing, and the operations are under the superintendence of Mr. Wünschendorff, Government telegraph engineer. The cable was hooked at the second drag fifty miles from Algiers, in 800 fathoms, but a coupling in a buoy-rope, which had been made hurriedly in Toulon, carried away, and the cable and 800 fathoms of rope were lost. The external condition of the cable, both as regards wire and outer serving, were excellent. The "Charente" has, after returning to Marseilles, gone out again to continue the operations of the repairs.

THE "INFLEXIBLE."—In reporting the trial of the "Inflexible's" guns, the *Standard* refers to the electric light as used on board the vessel. The report says:—"The experiments demonstrated that the electric light can be successfully used on board men of war, even during an action. The engine and boiler rooms and also the battery were illuminated by the Brush electric light, sixteen lamps, each of 2,000 candle-power, being brought into requisition, and in all these places the effect of the light was acknowledged to be equal to sunlight without being unpleasantly dazzling. Bow and mast-head lights were also tentatively used. It had been feared that the concussion resulting from the discharge of such monster pieces of ordnance would have broken the carbons, and have thus extinguished the lights, as they were not designed for ships; but the lights were in no way injured by the trials, and the fluctuations they underwent were comparatively insignificant.

THE MAXIM LAMP.—At the meeting of the National Academy of Science, New York, Nov. 16, Professor Morton gave the results of a recent series of measurements he had made with this lamp. In this lamp (vol. VI., p. 34), a filament of carbon is placed in a globe. The globe is exhausted to a certain point, then filled with gasoline. The electric current is then passed through. The gasoline is decomposed, and deposits carbon in the filament at its weakest and,

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therefore, hottest point. This quality of self-correction is as important to an electric lamp as to a schoolboy. The capacity of the lamp, according to Professor Morton, for developing light is remarkable. One lamp, showing a light of 40 candles, was run to 240 candles per h.-p.; another of 52 candles was run to 336 per h.-p.; another of 12 to 136 per h.-p. This latter lamp, with the light increased to 49 candles, was run to 426 candles per h.-p., and with the light of 98 candles was run to 607 per h.-p., and this was far within what the lamp would stand. The law of increase of efficiency with the increase of the intensity of action was thus verified. Professor Morton was unable to compare the Maxim and the Edison light because an accident happened to the apparatus of the latter. But arguing upon a letter received from Mr. Edison, Professor Morton said the Edison lamp compared with the Maxim as 155 to 240.

THE DUPLEXING OF SUBMARINE CABLES.—In duplexing long submarine cables it is found that one great point to be aimed at is to carefully reproduce in the artificial cable which balances the working cable an exact imitation of the first three hundred miles or so at each end of the working cable, both as regards the resistance and electrostatic capacity of each consecutive mile of cable in its proper relative position; and for this purpose the "section books" containing the tests of each mile of cable before it is added to the cable are consulted, and the artificial resistances and inductive resistances forming the artificial one made to correspond, the remaining portion of the working cable being represented in the artificial cable more in the gross than in exact detail. This shows that the labour expended on the careful compilation of exact tests during manufacture is not thrown away, but is becoming of increased importance. So sensitive is the balance to this exact representation of the first few hundred miles of cable that even a slight decrease in insulation at one spot within that distance can only be rebalanced by a similar decrease of insulation at exactly a corresponding spot along the artificial cable, and this seems to open out a new and accurate method of determining the distance and magnitude of a small fault of insulation. In fact, for finding the distance of a fault in a cable we should have for one side of the bridge an artificial cable having electrostatic capacity and resistances exactly similar to the cable under test when perfect.

MR. SWAN AT NEWCASTLE.—Mr. Swan has this Session been elected President of the Newcastle-on-Tyne Chemical Society, and in his inaugural address dealt specially with the subject of electricity, a subject with which his name is at present associated. He showed to his audience M. Jamin's electrical blowpipe. He said, "It consists, you see, of a pair of carbon pencils, an electric candle, in fact surrounded by a coil of insulated copper wire wound a few inches distant from the pencils in the place of their axes. The current is so led that, in circulating round the coil, it will attract the electric arc formed at the lower end of the carbon pencils, and cause it to flash out in the form of a fish-tail gas flame. This spreading out of the arc is the special feature of the action of the apparatus. It facilitates the application of the heat of the electric arc to the fusion of refracting substances, and enables us better to take advantage of this little-used means of producing a very high temperature." Some platinum was melted by the aid of the Jamin candle, and then Mr. Swan described "Siemens Electrical Furnace," and showed its action. He next referred to Planté's secondary battery, showing one charged in the morning, but not to its full extent. The result was satisfactory, and a piece of platinum wire was kept red hot for a considerable time. The lecturer said, "I would recommend it (the secondary battery) to the younger chemists of the society as a promising subject of study." One of the last experiments was to show the current used per lamp by nineteen of the Swan lamps used to light the room. A Siemens electro-dynamometer was used. The current used was nineteen webers per second, or one weber per second per lamp.

A NEW ELECTRIC PROPERTY OF SELENIUM.—At a recent meeting of the French Academy of Sciences a note was presented by M. Jamin on behalf of the author, M. R. Blondlot, giving an account of some interesting experiments made by him on a hitherto unknown property of developing electricity possessed by selenium, and which may prove useful in telephony. M. Blondlot exhibits the property by connecting a piece of annealed selenium by a platinum wire to one pole of a capillary electrometer, while the other pole is connected to a plate of platinum. If, now, the selenium, held by an insulating handle, be brought into contact with the platinum, the electrometer will remain at zero; but if the selenium be rubbed upon the platinum the electrometer shows a strong deflection, which easily amounts to that produced by a Daniell cell. Neither the friction of two metals against one another, nor that of an insulating body against metal, nor, rightly understood, that of two insulating bodies can produce a deflection of the capillary electrometer. The current produced by the friction of the selenium directs itself through the electrometer from the unrubbed surface of the selenium to the rubbed surface, showing that a difference of potentials is set up between these two surfaces. Now, the thermo-electric current obtained by heating the platinum-selenium contact flows from the hot to the cold selenium in the exterior circuit; and, consequently, the disengagement of electricity which M. Blondlot has observed cannot be attributed to the heat accompanying friction. This last point is important from theoretical considerations. The currents that M. Becquerel has obtained by rubbing two plates of metal against each other when connected to the two poles of a galvanometer are always, as M. Becquerel has proved, in the same direction as those that are produced in warming the surface of the rubber. M. Gaugain has attributed these currents to the heat produced by friction, and M. G. Wiedemann partakes of the same opinion. But the experiment made by M. Blondlot shows that in the case of selenium a direct effect from rubbing certainly exists, and it is probable that M. Becquerel's results are due to a similar cause. The Lippmann electrometer operates in M. Blondlot's experiments as a very sensitive galvanometer, free from a high resistance circuit. There is not in this case an equilibrium between the electromotive force of the meniscus of the electrometer and that of the source, because of the small quantity of electricity produced by the latter; the small quantity of high tension electricity produced by the rubbing communicates itself to the meniscus, and, seeing the great capacity of the latter, only raises by a very little the electric difference. This last fact explains a remarkable particular observed by M. Blondlot. If after having obtained by rubbing a deflection of the electrometer the rubbing be stopped, the deflection stops also. This is due to the selenium, which had allowed the friction electricity of high tension to pass, opposing a resistance which the feeble polarisation of the mercury of the electricity cannot overcome. Shock, and even pressure, produce the same effect that rubbing does, although in a less marked manner. Hence it is not unlikely that this newly-discovered property will find some applications.

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THE TELEPHONE CASE.

In the Exchequer Division on Monday Mr. Justice Stephen delivered judgment. There was a large attendance of the bar and the public, showing the interest evinced in the matter. Several ladies were accommodated with seats on the bench. His lordship delivered a written judgment as follows:—This was an information filed by the Attorney-General against the Edison Telephone Company of London (Limited), and heard before my brother Pollock and myself on the 29th of November and the following days. The facts were not in dispute, and they were as follow:—The defendant company was formed in August, 1879, for the purpose of working two patents granted to Mr. Edison—namely, one on the 30th of July, 1877, "for the invention of improvements in instruments for controlling by sound the transmission of electric currents and the reproduction of corresponding sounds at a distance;" and the other, on the 15th of July, 1878, "for the invention of improvements in telephones and apparatus employed in electric circuits." The nature of the instruments patented and the manner in which they are used by the company are as follow:—The telephonic apparatus consists of three parts—namely, first, an instrument called a transmitting instrument, into which a person speaks; secondly, an ordinary telegraphic wire through which an electric current passes; thirdly, an instrument called a receiving instrument, at which another person hears sounds. The transmitting instrument consists of a mouthpiece, into which the person using the instrument speaks; a tympanum, or disc, which vibrates under the impulse of the words spoken; and a substance brought into the lightest possible contact with the tympanum, and also brought into relation with the electric wire, the nature of which substance is such that the vibrations of the tympanum are by its means represented by variations in the electric current in the wire. The wire is exactly like any other telegraphic wire. The receiving instrument consists of a cylinder of chalk, which is damped by some chemical liquid, and is capable of being made to revolve by clockwork; a metal disc, which touches the cylinder of chalk; and a tympanum. When the apparatus is to be used the chalk cylinder is made to revolve, whereby friction is produced between the surface of the cylinder and the disc which touches it. The electric current passes from the wire into the chalk, and as it passes decomposes a part of the liquid by which the chalk is moistened. The amount of decomposition is greater or less according to the variations produced in the current by the vibrations of the tympanum at the transmitting end. The decomposition of the fluid varies the degree of friction between the chalk cylinder as it revolves and the metal disc applied to it. These variations are represented by vibrations in the metal disc, and these vibrations cause the tympanum at the receiving end to vibrate in correspondence with the vibrations of the tympanum at the transmitting end, and so to emit sounds equivalent to those which are uttered at the transmitting end. The sounds so reproduced differ from the sounds uttered by the speaker, but they reproduce these sounds with such precision and completeness that the voices of different speakers at the transmitting end can be recognized and distinguished from each other at the receiving end. This account of the apparatus used by the Telephone Company would, of course, be altogether incomplete for scientific purposes, but it is, we think, sufficient for the purpose of explaining our judgment. We must now state the manner in which the apparatus described is used by the company. They have a central office in Queen Victoria-street called the Central Exchange. They have also district offices in various parts of London called District Exchanges, and from the District Exchanges wires run to the houses or offices of subscribers in the neighbourhood. At each exchange, district or central, is an instrument called a switch board, by which any two wires running from that Exchange can be connected with each other. The switch board is an instrument well known in telegraphic operations, and is constructed as follows:—The wires running to the place where it is kept are brought down in front of the switch board in a vertical direction and parallel to each other. Behind, but not in contact with them, are horizontal wires. If it is desired to connect any two of the vertical wires, a metal peg is put through a hole in each of the vertical wires to be connected till the peg touches the horizontal wire running between and behind the vertical wire. The electric current in the first vertical wire then passes down the peg put through that wire, along the horizontal wire, up the peg passed through the second vertical wire, and along the second wire. If a subscriber (A) wishes to communicate with another subscriber (B), the process is as follows:—A first attracts the attention of a servant of the company stationed at the District or Central Exchange, as the case may be. He does this by pushing a button, by means of which an electric current lifts a spring which keeps in position a small metal shutter, covering a number corresponding to A's name. The shutter falls. The servant upon this sees A's number, and connects his own receiving instrument with A's wire. A thereupon names the person to whom he wishes to speak—namely, B. The servant puts A's wire in communication with B's wire, and shuts the shutter which had been opened, and A and B converse. When their conversation is over one or both pushes his button, and causes his shutter to fall, upon which the servant disconnects the wires. If the subscribers' wires are each connected with the nine District Exchanges, the words spoken pass over three separate wires, or portions of wire, which may belong to three different people—namely A's wire, which may belong to or be rented by A, the small length of wire on the switch board, which belongs to the Company, and B's wire, which may belong to or be rented by B. If A and B have to communicate through the Central Exchange, the words spoken would pass over five separate portions of wire—namely (1) A's wire, to the District Exchange, with which A communicates; (2) the Company's trunk wire from the District Exchange to the Central Exchange; (3) the small portion of wire on the switch board at the Central Exchange; (4) the Company's trunk wire between the Central Exchange and the District Exchange, with which B communicates, and (5) B's wire to the District Exchange, with which B communicates. Of these numbers, 2, 3, and 4 belong exclusively to the Company, No. 1 may belong to or be rented by A, and No. 5 by B. Agreements are made between the Company and its subscribers by which the wires and the telephonic apparatus necessary for working them are leased to the subscriber at a rent in consideration of which the Company contract, among other things, that they will, "Upon request made through the said telephone at any time during the continuance of this agreement, between the hours of 9 a.m. and 6 p.m., Sundays excepted, put the lessee in telephonic communication with the telephone of any other subscriber to the said Exchange whose wire is free." The rents are so calculated as to leave a profit for the company after paying the expenses of maintenance, &c. The information charges that the use in this manner of the apparatus described is an infringement of the exclusive privilege of the Postmaster-General as to the transmission of telegrams. We must now consider what that privilege is. It is created by the 4th section of the Telegraph Act, 1869 (32 and 33 Vic., chap. 73) in these words:—"The Postmaster-General shall have the exclusive privilege of transmitting telegrams within the United Kingdom of Great Britain and Ireland, and shall also within that kingdom have the exclusive privilege of performing all the incidental services of receiving, collecting, or delivering telegrams except as hereinafter provided." The third section defines the words employed as follows:—"The term 'telegram' shall mean any message or other communication transmitted or intended for transmission by a telegraph. The term 'telegraph' shall, in addition to the meaning assigned to it in the Telegraph Act, 1863, mean and include any apparatus for transmitting messages or other communications by means of electric signals." The Telegraph Act of 1863 defines "telegraph" thus:—"The term 'telegraph' means a wire or wires used for the purpose of telegraphic communication, with any casing, coating, tube, or pipe enclosing the same, and any apparatus connected therewith for the purpose of telegraphic communication." Putting these enactments together and substituting the definitions given for the words defined, the material part of section 4 of the Act of 1869 will stand thus:—"The Postmaster-General shall have the exclusive privilege of transmitting messages or other communications transmitted or intended for transmission by any wire or wires used for the purpose of telegraphic communication, with any casing, coating, tube, or pipe enclosing the same, and any apparatus connected therewith for the purpose of telegraphic communication, or by any apparatus (other than such wire) for transmitting messages or other communications by means of electric signals." In simpler language, the Postmaster-General is to have the exclusive privilege of transmitting messages or other communications by any wire and apparatus connected therewith used for telegraphic communication, or by any other apparatus for transmitting messages or other communications by means of electric signals. The result of the definition seems to be that any apparatus for transmitting messages by electric signals is a telegraph, whether a wire is used or not, and that any apparatus, of which a wire used for telegraphic communication is an essential part, is a telegraph, whether the communication is made by electricity or not. It would include, on the one hand, electric signals made, if such a thing were possible, from place to place, through the earth or the air; and on the other a set of common bells, worked by wires pulled by the hand, if they were so arranged as to constitute a code of a signals. By section 6 of the Act of 1869, "any company, corporation, or person who transmits, or aids, or is concerned in transmitting any telegram in contravention of the exclusive privilege above referred to is rendered liable to a penalty of £5 for every such offence." Penalties are not asked for by this information, but the allegation made by it is that an offence has been committed, and the question for our determination is whether this is or is not the case. The case for the Crown is that every such conversation as the one which we have supposed to take place between A and B is a "message or other communication transmitted by a wire used for the purpose of telegraphic communication with certain apparatus—namely, a transmitting and a receiving instrument—connected therewith for the purpose of telegrapic communication;" and that whenever such a conversation takes place the speakers and the company, by their servant, transmit, and that the company, at all events, aid and are concerned in transmitting such a message or communication. More particularly, it was argued that every member of this definition is satisfied by such a conversation so carried on. The conversation must be a communication, even if the word "message" is less appropriate. It is "transmitted" or sent through a wire used for the purpose of communication, and that communication is telegraphic according to the common use of language, though it involves no writing. The various affidavits filed give a complete history of the word "telegraph," and show that from the first invention of semaphores till within the last few years no contrivance of the sort did literally write at a distance, but that the word was applied to a variety of contrivances which, by signals perceptible sometimes by the sense of sight and sometimes by the sense of hearing, conveyed intelligence to great distances in a much shorter time than a letter could be carried. On these grounds it was said that to hold such a conversation as described was to transmit a telegram within the meaning of the Act. As to the exceptions, it was contended for the Crown that the burden of bringing the case within one or more of them was upon the defendants, which is no doubt correct. The arguments for the defendants may be reduced to three points—first, no communication by telephone is a telegram, because a telephone and a telegraph differ essentially; secondly, when two persons converse by means of a telephone they do not transmit a message or communication within the meaning of the Telegraph Act of 1869; thirdly, if such a conversation is the transmission of a message or communication within the Telegraph Act of 1869, it is within either the first or the second of the exceptions in section 5 of the Act of 1869. The first contention was supported by the following arguments:—It was argued that telephonic communication consisted in the transmission of the human voice to distances greatly exceeding those which it can naturally reach by means altogether unknown in 1863, or even in 1869, when the Telegraph Acts were passed which we have to construe, and this, it was said, is an entirely new result, produced by entirely new means. The transmitting instrument is, it was argued, quite new, the method of varying the force of the current in the wire by collecting and impressing upon it the vibrations of the human voice having been altogether unknown before the inventions of Mr. Graham Bell and Mr. Edison. In the same way the receiving instrument is absolutely new. In 1869 means were no doubt known by which the interruption and re-establishment of an electric current at the transmitting end of a wire would cause sound mechanically at the receiving end, but in such cases the sound was created at the receiving end—as, for instance, by magnetizing and demagnetizing a piece of iron, which when magnetized drew down on itself a small steel bar with a click, which resumed its position by means of a spring when the magnet ceased to act as such; but the transmission of the actual vibrations of the voice through the length of the wire and their re-translation into

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sound at the receiving end were unknown till the recent invention. Thus the means used were entirely new, and so was the result produced. This is forcibly stated in various affidavits made by men of the highest scientific eminence. Sir W. Thomson says:—"When the Telegraph Acts were passed the telephone had not been invented, and no one concerned in that legislation had the slightest idea, nor had any one living the slightest idea, that it would be possible so to extend the power of speech as to enable persons at a distance to converse with each other." Professor Stokes says:—"Neither the transmitter nor the receiver of the telephone in any way resemble in their mode of operation the corresponding parts of a telegraphic instrument, and if a single word is to be used to include both a telephone and a telegraph it must, in my opinion, be wide enough to cover every instrument which may ever be invented which employs electricity transmitted by a wire as a means for conveying information." Professor Tyndall says:—"Prior to the labours of Bell and Edison it had never to my knowledge entered into the thoughts of scientific men to transmit by means of electricity the tremors of the human voice, so as to reproduce audible and articulate speech at a distance. The proof that this was not only possible but practical appeared to those most familiar with experimental physics to be an application of electrical and acoustical science not only new, but marvellous. I have, therefore, no hesitation in expressing the opinion that to confound the telephone with the telegraph would be to place in the same category utterly dissimilar things." Dr. Fleming, who has been engaged for many years in the study of the subject, says:—"The Edison telephone is only a complicated form of speaking trumpet;" and he also says:—"When I, standing in an enclosed room, shout to another person in an adjoining room, the waves of sound from my voice beat against the wall, transmit their motion to the particles of the wall, and those again hand on the motion to the air in the other room. In this case the molecules of the wall constitute an apparatus by which motion of the air in one place is repeated in another. The Edison telephone does just the same thing." So Lord Rayleigh says:—"The speaking telephone is an instrument for artificially extending by the use of electricity the limits through which the human voice is audible. The only essential difference between a speaking telephone and a speaking tube is, that in the former vibrations are transmitted in the electrical, in the latter in the aerial form." Mr. Hopkinson says much the same at greater length. We see no reason to doubt the statements of these distinguished men as to the novelty and other scientific merits of the transmitting and receiving instruments. Our attention was certainly called to a remarkable passage in a work by the Vicomte du Moncel, published in 1857, which no doubt suggests the possibility of such a contrivance as the telephone. Much evidence was also given as to an instrument invented in 1861 by a German named Reis, which, it was contended, had more or less analogy to the telephone; but to these matters we attach no importance, because we cannot see in the speculation of Du Moncel or in what was done by Reis anything that can be said, either in science or practice, to have anticipated the telephone of Edison or of Bell. Whether it is correct to speak of the telephone as actually transmitting sound, and as being in the nature of a speaking trumpet or speaking tube, seems much more questionable. Sir George Airy, Professor Adams, and Mr. Siemens expressly deny it, for reasons which we need not quote at length. Sir George Airy gives his reason in a very few words:—"I do not believe that any such identity can be proved or reasonably stated to exist, and this I say for the reason that until we know the laws governing and the nature of the process which takes place during the transmission of sound through air we really know nothing as to the nature and mode of operation of electric currents, or waves, or impulses, or tremors." It was argued that no sound at all is perceptible between the transmitting and the receiving instrument; that the sound produced at the receiving end is produced not by the voice uttered at the transmitting end, nor by the vibrations set up by the voice in the electric current in the wire, but by the vibrations of the metal disc caused by the variations in the friction between the disc and the chalk cylinder. It was further said that the sound heard at the receiving end differs in a marked way from the sound uttered at the transmitting end, and that though the difference between two voices can be recognised at the receiving end, this no more proves identity between the sounds uttered and the sounds heard than the fact that you can distinguish the photograph of A from the photograph of B proves identity between the faces of A and B and the photographs of A and B respectively. A consideration not mentioned during the argument may perhaps be added. The telephone in the transmission of sound substitutes the velocity of light for the velocity of sound. If the sound made by the voice reached the receiving instrument of the telephone, it would reach it long after the telephone had spoken, and it seems difficult to say that two sounds separately heard one after the other are each identical with the sound uttered, especially when the one which arrives first makes a different impression on the ear both from the words as spoken and from the words as first heard. Mr. Cromwell Fleetwood Varley mentions that he and his brother arranged two parabolic sounding-boards in such a manner that they were accurately directed towards each other, and that words spoken by one brother into the focus of the one parabola were heard by the other brother at the focus of the other parabola at a distance of over two miles. It would take about eight seconds for the sound to traverse this distance. If, therefore, the words had been spoken into a transmitting instrument at one focus in telephonic connection with a receiving instrument in the other focus the one sound would have been heard eight seconds before the other. Can it be said that the two sounds were one and the same sound, or that the one sound travelled simultaneously over the two intervals of space at two different rates of speed? We do not think it necessary to express any opinion on a controversy which is more scientific than legal, and perhaps more properly metaphysical or relative to the meaning of words than scientific, as it seems to turn upon the nature of identity in relation to sound. It is enough to say that, whatever may be the merits of the controversy, it does not appear to us that the fact, if it is a fact, that sound itself is transmitted by the telephone establishes any material distinction between telephonic and telegraphic communication, as the transmission of it takes place, is performed by a wire acted on by electricity. We are of opinion, then, that fully admitting all that has been or indeed can be said as to the novelty and value of the telephonic transmitter and receiver, the whole apparatus, transmitter, wire, and receiver taken together, form "a wire used for the purpose of telegraphic communication, with apparatus connected therewith, for the purpose of telegraphic communication"—that is, they are a telegraph within the definition of the Act of 1863, which is embodied by reference in the Act of 1869. The wire is a wire. The transmitting and receiving instruments are apparatus connected therewith for the purpose of conveying information by electricity; and this, as it seems to us, is telegraphic communication. Indeed, though for scientific purpose it may no doubt be necessary to distinguish between telegraphs and telephones, it seems to us that the word "telegraph," as defined in the Telegraph Acts, is (to use Professor Stokes's words) "wide enough to cover every instrument which may ever be invented which employs electricity transmitted by a wire as a means for conveying information." Indeed, looking to the extension of the definition inserted in the Act of 1869, the words "transmitted by a wire" might probably be left out of this definition. That this view does no violence to the common use of language is proved first, by the fact that in Mr. Edison's own specification the words "telegraph" and "telegraphic" are frequently used in reference to his invention, and that in *Webster's Dictionary*, published in 1856, an electro-magnetic telegraph is defined under the head "telegraph," as an instrument or apparatus for communicating words or language to a distance by the use of electricity," and under the head "Electro-magnetic telegraph," as "an instrument or apparatus which, by means of iron wires conducting the electric fluid, conveys intelligence to any given distance with the velocity of lightning." Of course, no one supposes that the Legislature intended to refer specifically to telephones many years before they were invented, but it is highly probable that they would, and it seems to us clear that they eventually did, use language embracing future discoveries as to the use of electricity for the purpose of conveying intelligence. The great object of the Act of 1863 was to give special powers to telegraph companies to enable them to open streets, lay down wires, take land, suspend wires over highways, connect wires, erect posts on the roofs of houses, and do many other things of the same sort. The Act, in short, was intended to confer powers and to impose duties upon companies established for the purpose of communicating information by the action of electricity upon wires, and absurd consequences would follow if the nature and extent of those powers and duties were made dependent upon the means employed for the purpose of giving the information. Suppose a company found it essential to erect posts along a highway, and suppose the body having control of the highway gave their consent, would the validity of the consent, and therefore the liability of the parties concerned to an indictment for obstructing the highway, notwithstanding such consent, be dependent on the question whether the messages were sent by an Edison's transmitter or by a Morse key? Or, again, suppose that the Company favoured particular customers, and so enabled their friends to get great advantages in trade or speculation over other persons, could they say, "We have a right to do so, notwithstanding Section 41, because we use telephones and not telegraphs?" Or, still more, if one of their clerks negligently refused to send a message or improperly divulged its contents, would they, for the same reason, be deprived of the summary remedy given by Section 45? Nearly every section of the Act would supply an additional illustration of the general conclusion that, but for the monopoly established in 1869, the Edison Telephone Company would be as anxious to be included in the Act of 1863 as they are at present to be excluded from it; but this is only an accident, which cannot affect the interpretation of the Act. Looking at the Acts from the point of view of the Crown, we are led by a different road to the same conclusion. If a telephone is not a telegraph, then a telephonic communication is not a telegram, and if so any company may not only transmit such messages, but may perform all the incidental services of collection and delivery; and if this is so there is nothing to prevent all the railroad and other companies in possession of telegraphs from applying to them telephonic transmitters and receivers, and carrying on the business of telegraphy just as they did before 1869. The customer would write his message at the counter and the clerk would speak it through the telephone instead of using a less perfect instrument. It is difficult to suppose that the legislature intended to grant a monopoly so liable to be defeated, or that its language was meant to be so construed as to be limited to the then state of, perhaps, the most progressive of all sciences. In this connection we may dispose of one or two minor arguments by which it was attempted to show a distinction between telephonic messages and telegrams. It was said to be essential to a telegraphic message that it should be sent, not direct from party to party, but through the intervention of a messenger or clerk, and also that it should consist of signals having a conventional meaning, and not of actual words spoken. It seems to us impossible to regard these matters as essential to the process. A clerk may be regarded merely as an extra link in a chain of communication, and signals are only imperfect substitutes for words. It would be a strange thing to say that improvements by which a step in a given process can be dispensed with, and by which the process itself may be perfected, destroy the character of the process. To take such a view would be to affirm that imperfections in an instrument are essential parts of it, and that their removal destroys it. Apart from this a practical difficulty arises. There has been a constant progress in the subject of electric communication from its first invention to the present day. Some of the means employed require no code of signals, and some can be worked by any one who can read and write without any assistance from clerks. The A B C instrument worked by moving a hand successively to all the letters forming the message, and this moved a corresponding hand at the other end of the wire. Any two persons who could spell could use these instruments. Hughes's type-printing instrument prints the message in capital letters on a long narrow slip of paper. A telegraph called Cowper's writing telegraph has lately been invented, the nature of which is that a person holding a pen at one end of the wire can write or even draw with it, and that a facsimile is produced by a corresponding pen set in motion by the electric current at the other end of the wire. Two papers were produced before us written in what was said to be Chinese character and exactly resembling each other. The one was written by a Chinese lady, and the other by the pen at the other end of the wire. Now, either these instruments are telegraphs and the messages sent by them telegrams within the Act, or they are not. If Cowper's writing telegraph is within the Act it is difficult to say why a telephone is not. They equally dispense with clerks or messengers. If the sound is in any sense transmitted in the one case, the motions of the hand are in the same sense transmitted in the other. The one reproduces actual written words quite as accurately as the other reproduces words spoken, and if the one can properly be described as a complicated speaking trumpet, the other can with equal propriety be described as an elongated pen. If, on the other hand, Cowper's writing telegraph is not within the Act, it is

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equally difficult to say why Hughes's type-printer is within it. It requires no messenger or servant at least at the receiving end, and it employs no special code of signals. It is, however, impossible to doubt that it is included, for it was in common use long before the Act of 1869, having been invented in 1854, and having procured the Grand Prix for its inventor at the Paris Exhibition of 1867. The result seems to be that it is impossible to draw the line between these instruments, and that all or none must be regarded as coming within the definition of the term "telegraph," so often referred to. For all these reasons we hold that a telephone is a telegraph within the meaning of the Acts of 1869 and 1863. The second point made by the defendant company was that, whether the telephone was a telegraph or not, the conversations held through it were not "messages or communications" sent by a telegraph within the meaning of the Act. This contention was founded partly on the argument that the directness of communication between the parties to the conversation rendered the word "message" inappropriate, and partly on the Telegraph Acts of 1863 and 1868, which, it was said, use the word "message" in the sense of a substance with a message written upon it, and on the Telegraph Act of 1869, which, it is said, uses the word "communication" in a peculiar sense. As to the word "message," it is, no doubt, true that in several sections it is so used; but in others it seems to us to be used in the sense of the purport or tenour of the message. It is, for instance, an offence to delay to "transmit or deliver" a message. "Transmit" obviously applies to the words and not to the paper; "deliver" to the paper and not to the words; and so in other cases. The same remark applies to the Act of 1868, in which the word "message" is frequently used, and which was commented upon by Mr. Webster minutely. All the difficulties raised or attempted to be raised appear to us to be capable of solution by the single principle already stated. The word "communication" in the definition of "telegram" given in the Act of 1869 was said to have found its way there from sect. 16 of the Act of 1868, which authorises the Postmaster-General to make contracts with the proprietors of newspapers and others for the transmission or delivery of "telegraphic communications" to them at certain times and on certain terms, and it was rather suggested than expressly argued that such communications only would be telegrams within the meaning of the definition of the Act of 1869. We do not agree with this view. The use of the word "communication" instead of message in sect. 16 of the Act of 1868 certainly favours the opinion that there might be communications which would not be properly described as messages, but there is nothing in the definition of a telegram in the Act of 1869 which suggests that the word "communication" which it contains is to be restricted to the communications mentioned in sec. 16 of the Act of 1868. It is very possible that the use of the word in the one section may have suggested its use in the other, but there is nothing to narrow its sense in the last-mentioned section. For these reasons we hold that a conversation held through a telephone is either a message, or, at all events, a communication transmitted by a telegraph, which is the definition of a telegram. A small question was raised on the word "transmitted." When one person speaks to another it was said he "makes," but does not "transmit," a communication. The answer is that when he speaks through a wire some miles long he sends what he says through the wire, or transmits it. As the defendants contended that the very voice itself was so sent, this seems specially clear as against them. It was further argued that, admitting the conversations in question to be telegrams, they were still not within the Act of 1869, because the preamble of that Act recites that "similar powers to those conferred upon the Postmaster-General with respect to the exclusive privilege of conveying letters should be enacted with reference to the transmission of telegraphic messages." This, it is said, confines the exclusive privilege as to telegrams within the limits within which the exclusive privilege as to letters is confined, and subjects it to the same tacit exceptions. But the exclusive privilege of the Postmaster-General as to letters is "the exclusive privilege of conveying from one place to another all letters" (6 and 7 Wm. IV., chap. 33, sec. 2) subject to certain exceptions. No express exception applies to the case of a man who carries his own letter with his own hand to the person to whom it is addressed. Yet this exception has always been regarded as tacitly implied in the Act, and no one ever supposed that a man who came within it violated the Postmaster-General's exclusive privilege. It was argued that, in like manner, if two friends communicated with each other directly by a telegraph of which they were joint owners they would be outside of the sphere of the Act of 1869. To this argument there are, in our opinion, several conclusive answers. In the first place, we do not think that the recital in the preamble of the Act of 1869 ought to have the effect ascribed to it. Each Act must be construed independently. The practical inconvenience of construing the Post Office Act literally would be so very great that it can never have been seriously proposed so to construe it. It is enough to say that such a construction would have involved the consequence that when a letter was written it must be left on the table at which it was written till the postman called and took it away, visiting every room in every house for that purpose. Such a consequence is an absurdity, but there is no absurdity in supposing that the Legislature meant to prohibit private electric telegraphs. The extent to which they were intended to be prohibited will appear from the exceptions to be considered immediately. In the next place, there is no real analogy between a man carrying his own letter to his correspondent's house and two men telegraphing to each other. In the one case the act done can by no conceivable means injure the revenue. In the other case an apparatus must be employed which may readily be made to injure the revenue. The object of the Post Office Act is to give to the Postmaster-General an exclusive right to earn all that can be earned by carrying letters, but a man cannot pay himself for carrying his own letter. If he gets a friend to carry it for him he might pay, and this case is accordingly provided for by an express exception. In the third place, the customers of the Telephone Company do not in fact communicate directly with each other. They are put in communication by a servant of the company, and their messages travel in all cases over at least one wire, and in many cases over three separate wires which are the property of the company. On all these grounds we hold that the conversations held through the telephone are infringements of the Postmaster-General's exclusive privilege, unless they can be shown to be within the exceptions to that privilege. We now pass to two exceptions. Those which are said to apply are the first and second in section 5 of the Act of 1869. The first is in these words:—"Telegrams in respect of the transmission of which no charge is made, transmitted by a telegraph maintained or used solely for private use, and relating to the business or private affairs of the owner thereof." The second is:—"Telegrams transmitted by a telegraph maintained for the private use of a corporation, company, or person, and in respect of which, or of the collection, receipt, and transmission, or delivery of which no money or valuable consideration shall be or promised to be made or given." These exceptions resemble each other so closely that it is not easy to put a case of a telegram which would fall within the first exception and which would not fall within the second. Every "telegraph maintained or used solely for private use" must be a "telegraph maintained for the private use of a company, corporation, or person." A "telegram for which no charge is made" does not differ materially from a "telegram in respect of which, or of the collection, receipt, and transmission of which no money or valuable consideration shall be or promised" (the words "shall be" seem to be wanted before "promised") "to be made or given." And a message "relating to the business or private affairs of the owner" of the telegraph by which it is sent is a telegram. Thus the second exception seems to contain everything which can fall within the first and nothing more, except, possibly, telegrams not charged for transmitted by a telegraph used solely for private use and relating to the business of the owner of the telegraph, such telegraph not being maintained by the owner. But no case occurs to us in which a man is likely to own a telegraph and use it exclusively for his own business and yet not to maintain it. It was suggested that one of these clauses was added by way of amendment as the Bill passed through Parliament. It may be so, but it is difficult to conjecture what the object of the amendment can have been. Whatever may have been the history of the two exceptions the meaning of the first of them is in one point obscure. It authorises individuals to keep telegraphs for their own use, and to send messages by them relating to their own affairs, so long as no charge is made for the messages. This condition is to us unintelligible. How could a man make a charge to himself for sending a message on his own telegraph about his own affairs? It seems as if the exception had been originally intended to provide for two classes of telegrams, sent by telegraphs maintained or used solely for private use—namely, first, telegrams relating to the private affairs of the owner; and, secondly, telegrams relating to other people's affairs, sent as an exceptional favour and not charged for; but this is certainly not said. The second exception provides not only for most of the cases provided for by the first exception, but also for the case which seems to have been, for some reason, omitted from the first exception. The telegrams to which the second exception refers may relate to any subject so long as they are not charged for and so long as the telegraph by which they are sent is maintained for the private use of any corporation, company, or person. Upon the whole, the effect of the two exceptions seems to us to be that if a person, company, or corporation has a telegraph maintained *bonâ fide* for his or its own use—if, for instance, a banker has a telegraph to communicate between his office in the city and another office in a distant part of London, or if under the Act of 1868 (s, 9, 8) a railway has made arrangements with a coal master upon the company's system for a private telegraph between his coal pit and a station they may not only send telegrams on their own affairs, but may also, under special circumstances, and if no charge is made, send messages on the affairs of others. This view of the exceptions shows how wide the exclusive privilege granted to the Postmaster-General was intended to be. But for them it would be unlawful for the owner of works spread over a great space of ground to have a telegraph to communicate between the different parts of the establishment, or for a man of business with two offices in different parts of London to have a telegraph between them. This supports what we have already said as to the difference between the exclusive privilege of the Postmaster-General in relation to telegrams and in relation to letters. The privilege relating to telegrams seems to us to be the wider of the two. It was argued by the defendants that they were within the first exception, because in it the word "owner" ought to be read as including "owners," the effect of which was said to be that two persons might contribute to keep up a telegraph, and use it for communicating with each other on affairs interesting to either, that each of them might again communicate with others, and that thus the country might in theory be covered with a network of telegraphic wires, each connecting two persons only. It was further suggested that if this were lawful, it would be lawful in order to avoid circuity and complication to consolidate the individual wires into a small number owned by a large number of subscribers, and this it was said was practically what was done by the defendant company. This ingenious argument appears to us to be unfounded both in law and in fact. The exceptions seem to us to apply exclusively to telegraphs kept either by a single owner or under one express provision of the Telegraph Acts, like the one already referred to; but, quite apart from this, it is obvious that the telegraphs of the defendant company are neither owned nor maintained by the subscribers, nor are they used solely by the owners. The switch board and the trunk wires are the property of the defendant company, and they are essential to the system of communication adopted. Moreover, a charge in the shape of rent is made for the transmission of messages, and from this the company derives a profit. Each of these circumstances takes the case out of the exceptions, or rather prevents them from applying to it. Lastly, it was asked by the defendants when and by whom the offence, if any, of the defendant company, was committed. To this we think the answer is—that if several persons combine to do an illegal act each is guilty of the whole of it, so that when A sends a telegram to B by means provided by the company for that purpose and under the provisions of a contract by which it is carried out, A, B, and the company are all guilty of an offence under section 6 of the Act of 1869—namely, the offence of transmitting a telegram. Apart from this, we think that when the company's servant puts A in telephonic communication with B, the company aids and is concerned in transmitting a telegram, which, again, is an offence under the same section. The result is, that we give judgment for the Crown, with costs. There will, accordingly, be declarations in the terms of paragraphs 1 and 2 of the prayer, an injunction in the terms of paragraph 3, and an order that an account be taken as in paragraph 4.

Mr. WEBSTER prayed that the operation of the injunction might be stayed pending an appeal; the company were under terms to keep an account.

Mr. Baron POLLOCK: I dare say the Attorney-General will not oppose that.

The ATTORNEY-GENERAL: My Lord, the Postmaster-General is quite alive to the advantage arising to the public from the invention, and care shall be taken that no step shall be taken to stop it; but there must be some terms imposed, and the terms were agreed upon.

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THE TELEPHONE JUDGMENT.

Any satisfaction that may be got out of being thoroughly beaten was accorded in full to the Telephone Companies last Monday morning. It was no half and half decision, leaning to this side on one point, and to that on another, but a precise and categorical condemnation all round; and although the defendants gave notice of appeal the moment it was delivered, the judgment itself certainly presented no loophole or excuse for their doing so. Their motive, which is probably neither legal nor technical, but merely commercial, we have no wish to criticise too nicely, but it is impossible to feel much sympathy with it after reading the impartial, exhaustive, and masterly deliverance of the Court of Exchequer.

The result has probably surprised nobody, save, perhaps, a few over-credulous shareholders who may have hoped that sentimental considerations would prevail over law and common sense. What is really a subject for surprise is that the judgment is at once legal and technical—that its scientific dicta are not less conspicuous for clearness and accuracy than are those relating to purely legal issues. This is the more gratifying, seeing that great reliance was placed upon the affidavits of scientific experts on both sides, and it might reasonably have been feared that these would not receive adequate consideration at the hands of non-scientific judges. But fears of this kind, if ever entertained, have proved unfounded, for the Court showed itself as competent as the scientists themselves to deal with the subtleties of technical definitions; and, in one or two notable instances, demolished the experts with their own weapons. We have on two occasions, while this suit was pending, stated the contentions of the respective litigants with fulness and fairness, so far as they related to Acts of Parliament and public convenience. With regard to the disputed definitions of a telegraph and a telegram, however, we have left them to the judgment of our readers, believing that, considered apart from the special interests at stake in this dispute, divergence of opinion is simply impossible. This the Court has confirmed beyond all cavil, as we expected it would, notwithstanding the affidavits of several eminent scientific men to the contrary. How comes it, then, that these affidavits have been penned? The explanation is afforded by the Court, and we need not go outside its judgment to account for what at first sight seems inexplicable. The telephone is an entirely novel and unlooked-for application of electricity; it does not come within the historical definition of a telegraph, because it had no existence when that definition was framed; it does not transmit signals in the sense in which transmitted signals have been generally understood; and by a not unwarrantable strain of language it may be described as a vehicle for conveying the human voice. Thus the professional advisers of the Companies on these points have felt justified in declaring in effect that the telephone and the telegraph are "two utterly dissimilar things." No doubt they are, says the judgment of the Court; and, compared with the telegraphs mostly in use, so is the Wheatstone A B C, so, too, the Hughes type-printer, and so especially is Cowper's writing telegraph. None of these appliances effect communication by means of a preconcerted code of signals, upon which so much stress has been laid; yet no one pretends that they are not telegraphs even in the popular sense of the term, and in the case of the one last named it is as novel and as unlooked-for as the telephone itself. "If the telephone is an elongated speaking tube, then it follows that Cowper's telegraph is an elongated pen." The technical aspect of the question was practically settled by this singularly appropriate illustration; for the defendants' contention was that the telephone, not requiring what the Cowper instrument required—namely, manipulation by hand—the former is not and the latter is a telegraph. But if Cowper's is a telegraph there is not the smallest *technical* ground for denying that Edison's is a telegraph also. Arguments also based upon difference in the mode of dealing with the message to be transmitted disappear before the plain facts of the actual transactions, and are rendered absurd when the possible future transactions are considered. The appliances of bells, wires, and switches, served by attendants who are not the users, are so much superadded to the mere acts of speaking and listening; and as there is nothing to prevent, while there would be much to encourage, the practice of written messages transmitted and received by second and third parties, the upshot of their legal recognition would be that the privilege of the Postmaster-General might be universally evaded by simply adopting a telephonic form of instrument all round. The Court very properly ruled that a message, a communication, a telegram, or whatever else the thing may be called, is the same whether you write it, signal it, or speak it.

The comparison which one witness had the hardihood to draw between the diaphragms of two telephones and the two sides of a wall through which a couple of persons may converse is altogether beside the mark, seeing that the diaphragms do not convey sonorous waves, nor are the vibra-

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tions which travel through the wire identical either with the vibrations traversing the wall or with those originally set in motion. The vibrations which pass along the wire are electrical, not sonorous; and it may here be added that an electrical vibration (or "signal" as it is more commonly called in practical telegraphy) whether it be intermittent or undulatory is still electrical. The Court ruled, moreover, that, wire or no wire, the provisions of the Acts were so comprehensive as to probably cover any mode of transmitting messages whatsoever. Further, even assuming the acoustical comparison to be relevant, the Court called in question the popular notion that the vocal sound which is heard, for example, after a journey occupying several seconds is in strictness the same vocal sound. The distinction would, perhaps, be worthless except as showing that any artificial mode of projecting speech to a distance would come within the provisions of the Act if undertaken for profit.

And this brings us to a point very frequently urged on behalf of the telephone, that being for private use it is not a telegraph maintained for profit. This allegation was summarily disposed of. The telegraphs (or telephones) of the Companies are not private property, and are not let without valuable consideration, therefore they are encroachments on the public revenue, of which the Postmaster-General is the exclusive guardian. Whatever obscurity there may be as to what is meant by private telegraphs, private individuals, or corporations, there is none whatever concerning payment; and in answer to the challenge of the defendants as to *who* had infringed the Act, if infringement there had been, the Court emphatically replied, all the parties actually or responsibly concerned in its infringement.

The consequences that may follow on a strained interpretation of an Act of Parliament are, of course, no reflection upon the *bonâ fides* of those who claim to put that interpretation upon it. But as throwing light upon the intention of the legislature consequences are very material; and when the Bench drew attention to only a few of these which, to use its own language, were manifestly absurd, it becomes plain that the defendants' construction is inadmissible. To one of these—namely, the covering of the country with a network of telephonic speculations—we have already adverted. But not only might the property which the State has acquired at an enormous outlay be seriously depreciated, but those safeguards which have hitherto hedged round all telegrams and telegraphs—giving them due precedence, secresy, and protection—would henceforward be inoperative in respect to telephony if telephony is outside the Acts. We commend this consideration to the public as well as to the Companies. They cannot claim protection under enactments which they do not recognise, nor can they hope to obtain protection without surrendering their pretensions. In the words of the Court, there is not the least doubt that had these Companies existed prior to 1869 they would have claimed protection under the existing Acts; nor is it doubtful that when the State purchase of the telegraphs was effected they would have claimed to be purchased as telegraphs. It is in the highest degree improbable the State would purchase them now. Should, therefore, the appeal go against them they will have to admit that they are telegraphs, and submit to the regulations as well as the royalties which the Public Telegraphs Department sees fit to impose.

GOVERNMENT ORDER FOR TELEPHONES.—The Post Office authorities have given an order for 20,000 Gower-Bell telephones.

HISTORICAL MEMORANDA ON SUBMARINE TELEGRAPHY.

BY F. C. WEBB, M.I.C.E., M.S.T.E.

(CONTINUED FROM PAGE 21.)

1854 (continued).—In this year Messrs. Glass and Elliot, of East Greenwich, made twelve miles of cable, which was laid between Sweden and Denmark. It had three No. 16 conductors, each covered to No. 2 with G.P., and ten No. 2 galvanised iron wires for sheathing. This was, it is believed, the first cable made by Messrs, Glass and Elliot, which firm, combined with the Gutta Percha Company, forms the present Telegraph Construction and Maintenance Company. In this same year this firm manufactured a cable to be laid between Spezzia, in Sardinia, and the island of Corsica, 110 miles long, and one to be laid between Corsica and the island of Sardinia, across the Straits of Bonifacio. The pattern of these cables was six conductors of No. 16, covered to No. 1. with G.P., and sheathed with twelve No. 1 ungalvanised iron wires. These cables were laid in June of this same year from the s.s. "Persian." Mr. H. Brett was responsible for the laying of these cables, and engaged Mr. Thomson, formerly Mr. R. S. Newall's principal engineering assistant on such expeditions, to assist in the work. The depth of water (350 fathoms) was much greater than had previously been dealt with, and the cable being a heavy one strong break power was required. Two drum breaks were used. Each drum had two break straps, one on each side of the part round which the cable passed. These drums were placed one behind the other. The cable was to make five turns round the foremost drum, and then pass on to the after drum, round which it was to take four turns. The four break handles had tackles on them fast to the deck, so that the handles could be boused down, and thus the break power was considerable. There were wood blocks on the break straps, and the author believes the drums were 8ft. diameter. There was no stern wheel, but only a saddle over the taffrail. Some kind of movable knife was used, which was held by two men, but this was strongly objected to by Mr. Thomson. The following account is from some notes given to the author by Andrew Nelson, a steady-going Swede, who was present on board during the laying, and who for many years was foreman under the author on board the "Monarch," where the poor fellow was eventually killed (after the author left the ship) by being dragged into the picking-up machine on a fine summer's day, when cable was being picked up in the North Sea.

The "Persian" arrived at Spezzia July 21, and landed end at 9 a.m., and payed out till 10 p.m., when they brought the ship up by the cable for the night. July 22, at 4 a.m., something wrong with cable ashore (electrically), and after consultation a steamer was sent back to Spezzia to see what was the matter, and found the clerk asleep and the cable disconnected; commenced paying out again, and went on until 2 p.m., when they had a broken wire, which carried the knife under the drum and flattened the cable. They then cut the cable, and removed the damaged part, spliced up, and proceeded at 4 p.m., until 10 p.m., when they again brought up by the cable for the night. July 23, 4 a.m., commenced paying out, and soon stopped to "ship the other drum" (that is, it may be supposed that up to this only one of the drums was used, and that now the second was placed in circuit by having turns taken round it). In stopping, they damaged the cable, and in repairing it damaged also the taffrail. Laid to for the night. July 24: Commenced paying out, and got to Cape Corsica at 10 p.m., and brought the ship up for the night. July 25: Landed the end at 11 a.m., 94 miles having been paid out in distance of 74 miles.

It appears that the cable often surged alarmingly on the drums. There was no holding back gear, except a nipping arrangement, made by something like a pair of nut-crackers. The fleeting knife, not being fixed to the frame, as had always been the case on all former expeditions, but only held by two men, appears to have been the principal cause of the accidents. The cable, however, was eventually laid in good electrical order. The deepest water previously encountered had been 180 fathoms, viz., on the Portpatrick and Donaghadee line, and here the depth crossed was about 350 fathoms, so that the final success was certainly creditable, and indeed no cable of so heavy a type has, we believe, been ever laid since in such deep water. The electrical tests of this cable were under Mr. H. V. Physick, formerly assistant engineer to the Electric Telegraph Company. The cable lasted good for many years, but when it failed it was never repaired. These cables, made by Glass and Elliot, had a left hand lay, Newall's cables having been right hand.

In the latter part of this year one of the Hague cables failed about thirteen miles from the Dutch coast. The ports on the Dutch coast would soon be frozen, and it was considered unsafe to have a steamer working on that coast under the circum-

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stances. The author was instructed to attempt the repair in a Dutch fishing smack, and some particulars of the work have already been given in this journal.

1855.—In this year Mr. H. Brett attempted to lay a cable between Cape Spartivento, the southern point of the island of Sardinia, and the coast of Algeria, near Bonah. The cable was of the same type as that laid the previous year between Sardinia and Corsica, and made by the same firm. Mr. Brett, however, seems to have been over confident, for although he had to cross depths of some 1,500 fathoms, or about five times the depths he had previously crossed with such difficulty, he not only attempted to employ a sailing ship in tow, instead of a steamer, but also dispensed with the services of Mr. Thomson, the experienced engineer who had helped him through the previous work.

The sailing ship "Result" was employed, and 150 miles were shipped. The same breaks were employed, but it appears with too few turns round the drums; for on getting into some 600 fathoms about twenty-five miles out from land, the cable began to run out faster and faster, and at last, though the drums were brought to a stand by the break straps, the cable continued to surge round with fearful velocity, at last dragging up a great skein, and thus the cable had to be cut and the end abandoned.

The quantity left was not enough to reach the opposite coast, and the piece laid was therefore grappled up near the shore and cut, and then the sea part was passed into the ship forward, and spliced up to the cable leading to shore. But whether turns were taken round the windlass, as the author has heard stated, he cannot say. But certainly some twenty miles or so were under run in some way, and then the cable was cut again, and the part leading seawards was abandoned. The part leading to shore was then spliced on to the cable remaining in the hold, and paying out resumed; but in another short distance again a run took place, and the cable had to be cut. After this the work was abandoned, seventy miles having been lost in all, and eighty brought home.

These pieces laid, together with a portion of another cable lost next year by Mr. Brett, were recovered in 1858 in the s.s. "Elba," by R. S. Newall and Co., Mr. Liddell, assisted by the author and Mr. Fleeming Jenkin, having charge of the work, and, by a careful measurement of the pieces recovered, it was clear that the second start was made with less cable on board than could possibly reach the opposite coast, from the point where it was spliced on to the portion already laid, even if the cable had been laid without slack. The sea ends of the two pieces terminated, the one in an immense skein of seven parts of cable, which, when coiled away, covered the whole of the bottom of a tank, and the other in a shorter but broader entanglement, which could not be got in at the bow sheave at all, but had to be got in by mast head and fore yard tackles. A photograph of one of these knots was for many years to be seen in the window of Mr. R. S. Newall's shop in the Strand.

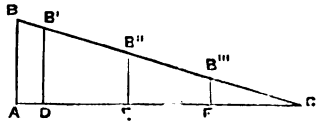
LESSONS FOR LEARNERS.

Instead of making the connections with wire, if I use pieces of glass, ebonite, or sealing wax, we shall find no stir in the galvanometer needle, and these pieces may be almost as short and thick as you please. See, here is a huge lump of sealing wax, making the connection, but we get no movement of the needle. Just as a given head of water was sufficiently powerful to overcome a certain resistance only, so that property of a cell which is similar to "head of water" will enable the current to overcome a certain resistance only, and if the resistance to its passage be too great, the current does not pass. Again, the greatest force of the water due to height is utilised only just when the resistance offered is barely to be overcome. We may have a pipe, for instance, closed by a spring which exerts a pressure of 2lb., and the water from the cistern just manages to push aside the valve. If we replace this spring by another, exerting only a pressure of 1lb., the water will not exert all its force. By using a stronger, and a stronger spring, we at last come to the point when the water just counteracts the one, but will not move the next stronger. With the one it just counteracts the water utilises its maximum force. Here what is good for water is good for electricity.

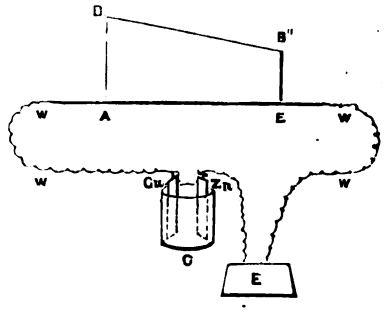
The property of electricity about which I have been speaking is called *potential*. Just as water runs from a higher to a lower level, so electricity goes from a higher to a lower *potential*. Just as water at a certain level cannot flow if the resistance to be overcome is too great, so the electricity at a given *potential* cannot overcome more than a certain resistance. *Potential*, like head of water, utilises its greatest strength just before the resistance becomes too much for its powers.

I have tried to help you to understand the electrical condition termed "potential," because it has so often been and is so often used as a term without any meaning or idea of meaning attached to it. Try your best to grasp its meaning, and if you succeed you will have overcome a greater stumbling-block to electrical students than the Ass's Bridge is to Euclidean students.

Look at this cell again. You see the zinc and copper plates are partly in and partly out of the liquid. The zinc plate is in the cell, connected to the copper plate by means of the acidulated water, whilst outside they are connected by the air or by a piece of wire, or by some other material. From the zinc plate, through the liquid, the copper plate, the outside connecting material to the zinc plate again, is a complete circuit, and this circuit possesses many attractions for us. We have seen that, in order to get a current, the resistance between the terminals must not be too great, or the potential of the cell is powerless to send a current. We must look upon the potential of any given cell as constant.



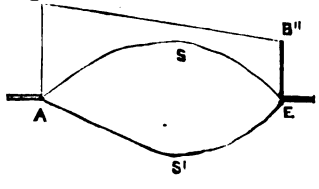
The height of water is always reckoned from the level of the sea. Electrical potential is always reckoned from that of the earth, which is taken as zero. We can show a good deal about the fall and rise of potential by means of lines. Suppose, for instance, A C represent a wire, the electrical potential of which, at A, may be represented by the line A B. If the wire A C is continuous, and at the point C the potential is zero, that is, the same as the earth, the potential will fall uniformly from A to C. Join B C, and at any points D, E, F in A C draw perpendiculars D B', E B'', F B'''; these perpendiculars will represent the potentials at these points. The difference of potentials at A and C determines the current from A to C, similarly the difference of potentials at A and D, that is, B—B', determines the current from A to D, or the difference of potentials (viz., B—B'') at A and E determines the current from A to E, and so on. We have seen that there is no flow of water from points at the same level, and we shall find also that there is no current of electricity from points at the same potential, although those points may be joined by material offering little resistance to the current.



Let C represent the battery. Cu and Zn the terminals of the copper and the zinc plates respectively joined by the wire W W to a plate of metal in moist earth. Thus the ends of the wires are at zero potential. Take any points A and E in the wire W, and let A B and A B'' represent the potentials at these points.

Suppose the wire from A to E to be split longitudinally exactly through the centre so that the one side is the exact counterpart of the other, and open out the wires thus:—

The current from A passes through the two portions A S E A S' E to E, and as A S E. A S' E are exactly similar there is no reason why a greater portion of the current should go through the one than through the other, and, in fact, if we test, as we can easily do by inserting two similar galvanometers one in each branch, the needle in both cases is similarly deflected. I now



take a galvanometer, to the terminals of which are fixed wires, and at the free ends of the wires, clips, to make contact at any point I choose. One clip I fasten to one branch and the other to the other. You see the moment I make the second contact the

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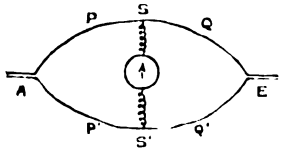
needle shows a current, but I slide the clip along till I come to a point where the needle is not deflected, and on measuring I find the clips at S and S′ to be at equal distances from A or E, also if I place the clips at P and P′, or at Q and Q′, I find the needle does not move; but if I place one clip at P and the other at S′, or one at P′ and one at S′, or in any position where the points of the



arms are not at equal distances from A or E. I get a swing of the needle directly. The potentials at P and P′, at S and S′, at Q and Q′ are the same, and so there is no current between these points when joined by a good conductor. What however I want you to remember is not that the length A P is equal to the length A P′, but that the resistance of the wire A P is equal to the resistance of the wire A P′, the same with A S and A S′, and A Q and A Q′. It is only because we split the wire so exactly that the same length gives the same resistance. In order that the galvanometer should give no deflection it is necessary that the branch A S should be equal in resistance to the branch A S′ when the contacts are made at S and S′.

(TO BE CONTINUED.)

ON A THERMO-MAGNETIC THERMOSCOPE.

BY SIR W. THOMPSON.

This thermoscope is founded on the change produced in the magnetic moment of a steel magnet by change of temperature. Several different forms suggest themselves. The one which seems best adapted to give good results is to be made as follows:—

1. Prepare an approximately astatic system of two thin hardened steel wires, $r\ b$, $r^1\ b^1$, each one centimetre long, one of them, $r\ b$, hung by a single silk fibre, and the other hung bifilarly from it by fibres about three centimetres long, so attached that the projections of the two on a horizontal plane shall be inclined at an angle of about ·01 of a radian (or ·57°) to one another.

2. Hang a very small, light mirror, bifilarly from the lower of the two wires.

3. Magnetise the two wires to very exactly equal magnetic moments in the dissimilar directions. This is easily done by a few successive trials, to make them rest as nearly as possible perpendicular to the magnetic meridian.

4. Take two pieces of equal and similar straight steel wire, well hardened, each two centimetres long, and about ·04 centimetres diameter. Magnetise them equally and similarly, and mount them on a suitable frame to fulfil conditions.

5 and 6. Call them R B and R¹ B¹, B and B¹ denoting the ends containing true north polarity (ordinarily marked B), and R R¹ true south (ordinarily marked red). The small letters, r, b, r^1, b^1, mark on the same plan the polarities of $r\ b$ and $r^1\ b^1$.

5. The magnets R B, R¹ B¹, are to be relatively fixed in line on their frame with similar poles next one another, at a distance of about two centimetres asunder, as thus, R B . . . B¹ R¹, with B B¹ = two centimetres.

6. This frame is to be mounted on a geometrical slide upon the case, within which the astatic pair, $r\ b$, $r^1\ b^1$, is hung in such a manner that the line of R B, B R bisects $r\ b$, approximately at right angles, and that R B B R may be moved by a micrometer screw through about a millimetre on each side of its central position, the line of motion being the line of R B. B¹ R¹, and the "central position" being that in which B and B¹ are equi-distant from the centre of $r\ b$.

7. A lamp and scale, with proper focussing lens if the mirror is not concave, are applied to show and measure small deflections as in my mirror galvanometres and electrometer.

USE OF THE THERMOSCOPE.

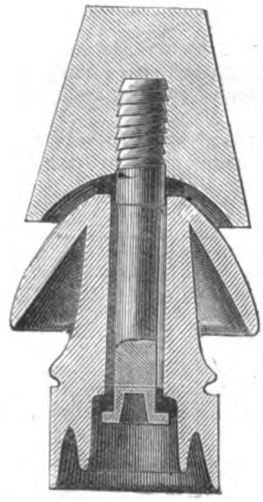
8. Place the instrument with the needles approximately perpendicular to the magnetic meridian, turning it so as to bring b and b to the south of the vertical plane bisecting the small angle between the projections of $r\ b$, $r^1\ b^1$ and r, and r^1 to the north side of it.

9. By aid of the micrometer screw bring the luminous image to its middle position on the scale.

10. Cause R B, B¹ R¹ to have different temperatures. The luminous image is seen to move in such a direction as is due to r approaching the cooler, and receding from the warmer of the two deflectors B R, B¹ R¹.—*Proceedings Royal Society Edinburgh.*

NEW TELEGRAPH INSULATOR.

The insulator represented in the annexed engraving was originally designed to meet the requirements of South American telegraph service, but it is equally well adapted to lines in other places. The main idea is to avoid breakage from expansion and contraction in a climate subject to sudden changes of temperature, and to avoid the mischief occasioned by a well-known South American bird, the "hornero," by building nests of mud on the brackets and insulators. With this insulator these nests cannot cause a weather contact or earth; on the contrary, the nest rather improves the insulation. The sectional view in figure shows the construction of the insulator and the manner of

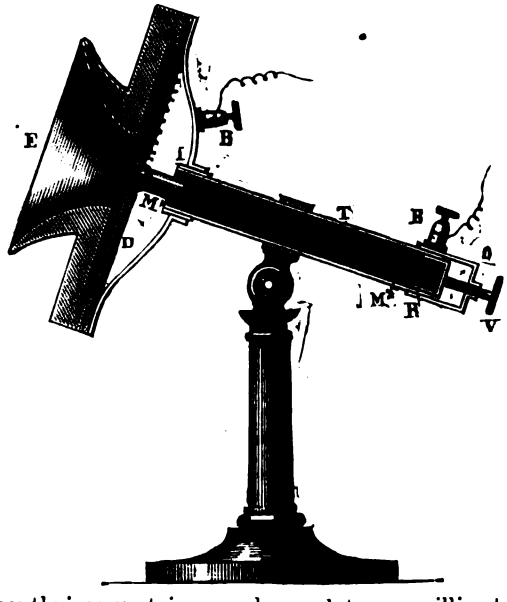


fastening it to the cross arm or bracket. A rubber ring is placed between the upper end of the porcelain insulator and the cross arm, and another similar ring is placed between the head of the suspending screw and the bottom of the insulator. It will be noticed that with this construction the insulator cannot be broken by the contraction of the screw or by the swelling of the cross-piece. This insulator can be used on an iron bracket and in connection with either iron or wooden posts, and is in every way more secure than the insulators in common use. The first cost of these insulators compares favourably with the cheapest in the market, while it is less liable to breakage, lasts longer, and gives better results.—*Scientific American.*

NEW MICROPHONE.

BY M. BOUDET, OF PARIS.

This microphone, with multiple contacts, as shown in the accompanying figure, is composed of a mouthpiece, E, affixed to the end of a glass tube, T, one centimetre in diameter, itself fixed on a jointed stand, thus enabling the whole apparatus to be moved at any inclination.



The mouthpiece contains an ebony plate one millimetre thick, on which is fixed a piece of copper, M¹, penetrating the glass

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tube a slight distance. In this tube there are six carbon balls slightly smaller in diameter, so that they can easily be moved.

The microphone is completed by a second piece of copper, M^2, supported on the end of a hollow breach, K, by means of a little spiral spring not shown in the figure. The screw V fixed in the cup Q serves to regulate the pressure of the piece M^2 against the balls. The variations in the resistance of the microphone are reproduced equally through all the contacts of the balls, because, when talking at the mouthpiece, the vibrations are transmitted almost instantaneously, as in the well-known case of billiard balls.

The apparatus acts like an ordinary middle-sized Gaiffe microphone, with six elements (peroxide of manganese and chloride of zinc) set up with a resistance of 800 ohms,* with a Bell telephone for receiver.

By employing inductive currents and a fine wire telephone receiver—a necessity with inductive currents—the distance may be largely increased, and extended, with artificial resistances, to 250,000 ohms.

We have been present at experiments made with this microphone, and we have found that it transmits the voice very clearly, without altering the tone and without any scratching sounds.

THE SOCIETY OF TELEGRAPH ENGINEERS.

Wednesday, Dec. 22, 1880.

The report of the Council read at the annual meeting showed that during the year 60 new members had been elected, 17 were nominated, whilst 29 had left the Society. The report noticed the papers read at the meetings of the Society during the year, and referred to the addition in the *Journal* of the Abstracts of Papers from foreign and other sources. Credit was taken for the completion of the Ronalds catalogue and the binding of the books, under the able superintendence of Mr. Frost. The library is to be opened to members, members of scientific societies, and the public, under certain conditions, from January 1, 1881. The report stated that the finances of the Society were in a good condition, that the loan contracted two years ago was all paid off; and the Society was free from debt.

Votes of thanks were passed unanimously to the Institute of Civil Engineers for permission to use their hall for general meetings, and to the hon. solicitor for his untiring energy in the legal work of the Society. The secretaries reported that the following gentlemen were elected officers of the Society for the session 1881 :—

PRESIDENT : Professor G. C. Foster, F.R.S.

PAST PRESIDENTS : Charles William Siemens, F.R.S., D.C.L.; Frank Ives Scudamore, C.B.; Sir William Thomson, LL.D., F.R.S.; Latimer Clark, C.E.; C. V. Walker, F.R.S.; Professor Abel, C.B., F.R.S.; Lieut.-Col. J. U. Bateman-Champain, R.E.; W. H. Preece, M. Inst. C.E.

VICE-PRESIDENTS : Lieut.-Colonel C. E. Webber, R. E.; Willoughby Smith, Professor W. G. Adams, F.R.S.; C. E. Spagnoletti, M. Inst. C.E.

HON. TREASURER : Edward Graves.

HON. SECRETARY : Lieut.-Colonel Frank Bolton.

COUNCIL: W. S. Andrews, Wm. T. Ansell, Sir Charles Bright, Lieut. P. Cardew, R.E.; R. E. Crompton, H. G. Erichsen, H. C. Forde, M. Inst. C. E.; Colonel Glover, R.E.; Professor D. E. Hughes, F.R.S.; J. F. Moulton, F.R.S.; A. Siemens, Augustus Stroh, and C. F. Varley, F.R.S.

TRAFFIC RECEIPTS FOR NOVEMBER, 1880.

COMPANIES.	Nov., 1880.	Nov., 1879.	Increase.	Decrease.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	1,900 estd.	3,110	—	1,210
Direct Spanish Telegraph Company	1,465	1,334	131	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	47,669	46,147	1,522	—
Eastern Extension Telegraph Company	29,724	26,379	3,345	—
Great Northern Telegraph Company	20,800	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

* Taking its practical value, the resistance of one ohm represents that of a pure copper wire one millimetre in diameter and 48m. 5 in length, or about 40 metres of the copper wire of commerce of an equal diameter, or, yet again, 97 metres of iron wire four millimetres in diameter (ordinary telegraph wire).

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES DEC. 22.		BUSINESS DONE WEEK ENDING DEC. 22. Highest.	Lowest.
Anglo-American Ordinary	62¼, ⅜		63	62
Do. "B"	92, ⅜		92¾	92
Do. "A"	33½, ¾		34	33
Brazilian	9 15-16, 10 1-16		10⅛	9 15-16
Cuba	8¾, 9		9	8¾
Do. Ten per Cent. Pref.	16½, ⅛		—	—
Direct Spanish	2⅞, 3⅛		—	—
Do. Ten per Cent. Preference	12½, ¼		—	—
Direct United States	11⅜, ⅜		12	11⅛
Eastern	9⅝, ⅜		9 15-16	9⅝
Do. Six per Cent. Debenture	102, 105		—	—
Do. Five per Ct. do. 1899	102, 104		105½	105½
Do. Six p Ct. Pref	12⅜, 13		12⅞	12⅜
Eastern Extension	10 1-16, 3-16		10⅛	10⅛
Do. Six per Ct. Deb	109, 112		—	—
German Union	10½, ⅜		—	—
Globe Telegraph & Trust	6⅜, ⅛		6 15-16	6⅜
Do. Six p Ct. Preference	12½, ¼		12½	12
Great Northern	10½, 11½		11⅜	11
Indo-European	25, 26		—	—
Mediterranean Extension	2⅜, 3⅛		3⅛	3
Do. Eight p Cent. Pref	10⅜, 11¼		—	—
Reuter's	10⅜, 11½		11½	11
Submarine	260, 265		—	—
West India and Panama	2, ¼		2 5-16	2
Do. Six per Cent. 1st Preference	6⅜, 7½		7½	7
Western and Brazilian	9, ⅛		9 3-16	8 15-16
West. Union 7 p. Ct. 1st Mt.	120, 125		122½	122
Do. Six per Ct. Sterg.	104, 107		—	—

V. R.

TELEPHONE INTERCOMMUNICATION.

The POST OFFICE has for some time provided a means whereby the Renters of wires into Postal Telegraph Offices may be placed at will in DIRECT COMMUNICATION with each other.

Such a system has been in operation in Newcastle-on-Tyne, Hull, Middlesbro', Stockton and other Towns for several years.

The instrument used in these cases up to the present time has been the A B C instrument.

Henceforward, in order to meet the convenience of the public, the Post Office will be prepared to provide for such a system either the A B C or the Telephone instrument.

In the case of the Telephone instrument the annual charge to each Renter in London will be £15 if his premises be within half a mile of the Telegraph Office, £19 if they be more than half a mile but not more than a mile distant, and at proportionate rates for greater distances.

The Renters will not only have the facility afforded them of communicating direct with each other, but they will also be enabled to send messages by wire to the Telegraph Office to be thence transmitted at the ordinary charge to other towns.

Application should be made to the Secretary, General Post Office; and when several persons in any one neighbourhood have agreed to take wires, immediate steps will be taken to establish a system of intercommunication by Telephone Instruments.

BY ORDER OF THE POSTMASTER-GENERAL.

December, 1880.

TELEPHONES.—The attention of the Directors of the United Telephone Company (Limited) having been called to certain ADVERTISEMENTS by the POSTMASTER-GENERAL offering to supply the public with Telephone Instruments in connection with private wires and upon the exchange system, NOTICE is hereby Given that the Patent Rights in this country of Professor Grahame Bell and Mr. Thomas Alva Edison are the exclusive property of the United Telephone Company (Limited), and that PROCEEDINGS will be TAKEN against ALL PERSONS USING ANY FORM of CARBON TRANSMITTER, or any form of Magneto or Electro-Chemical Receiver, whether such Telephones are supplied by the POSTMASTER-GENERAL or by any other person not authorised by the United Telephone Company (Limited), all such Transmitters and Receivers being infringements of the said Patents.

By order of the Board,

JAMES BRAND, Chairman.

Dated this 21st day of December, 1880.
36, Coleman-street, London, E.C.

TELEPHONES.—With reference to an advertisement, signed by the Chairman of the United Telephone Company (Limited), threatening legal proceedings against the users of Telephones supplied by the Postmaster-General, the GOWER-BELL TELEPHONE COMPANY (Limited) hereby give notice :—

1. That H.M. Postmaster-General has contracted with this Company for large supplies of Gower-Bell Loud-speaking Telephones, having found this to be the only form of telephone which has sustained the official tests for efficiency, simplicity, and permanence of operation.

2. That the telephones sold by this Company are manufactured under agreement with the United Telephone Company (Limited), and that that Company has been, and is directly, interested in the profits arising from such sales.

By order,

J. A. MAYS, Secretary.

No. 9, Great Winchester-street, London, E.C.,
22nd December, 1880.

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ABSTRACTS OF SPECIFICATIONS.

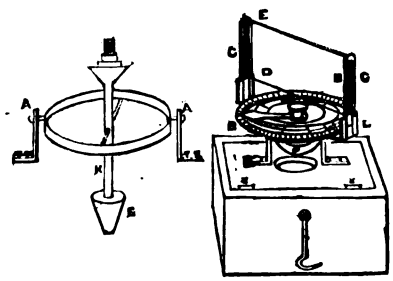
—o—

We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts—ED. *E.*]

1934. IMPROVEMENTS IN ADJUSTING AND CORRECTING DEVIATIONS IN THE MARINER'S COMPASS.—*By Henry James Thatcher, of Cardiff.*

The instrument consists of a flat circular plate made of German silver, and divided and marked precisely the same as a compass card, the plate being fitted and arranged so as to turn horizontally on the shoulder of an upright brass rod, K, swinging in gimbals, A B, and having a lead weight at the bottom so as to keep it always perpendicular. Below the metal card a flat brass bar, L, is made to revolve upon a second shoulder of the upright rod, but made so as to turn easily without touching the metal card. This flat brass bar has its ends turned up at right angles to the edge of the metal card, so that when the bar is in its place on the shoulder of the upright rod, and the metal plate is also in its place, the ends of the bar extend upward above the plate about the distance of one inch, and the ends of the wire D are permanently fixed into the two upright ends of the brass bar. The perpendicular brass rod K is filed square, immediately above where it passes through the metal plate, the square corresponding to and fitting into the socket of a metal hand, the hand being intended to remain fixed in one direction, while both the metal card and the brass bar underneath revolve freely. Above the square the pendicular brass rod, K, is tapped with a screw thread to receive a short thumb screw, which answers the double purpose of clamping the metal card, and also showing the exact centre of the card. In each of the upright ends of the flat bar two dovetail slots are filed to receive the ends of two

1934



azimuth sight vanes, exactly the same as in an ordinary azimuth compass. These sights have also a small slot in the top of each, so as to receive the ends of a thin wire strained across from one to the other. When using the instrument the first thing to be done is to place it so that the hand on the dial points in the direction the ship is going; then you look at the compass you wish to correct, and see how the ship's head is by that compass, and then you turn the dial round until the hand points to exactly the same degree on the metal plate as the lubber line of the compass shows the ship's head is. If the sun is shining all that is now required is to turn the flat bar round until the shadow of the cross wire falls upon the little black speck in the centre of the metal card. By looking at the little indicator you will then see at once the bearing of the sun by the metal card, and as this metal card is exactly the same as the compass you are correcting you have the bearing of the sun by the compass. Reference to Burdwood's azimuth tables will give the true bearing, and the difference is, of course, the deviation and variation combined. The sight vanes are for taking bearings of any object it may be found desirable to correct the compasses by, and the cross wire over all is to take the bearings of the North Star or any other heavenly body whose altitude is too great for the ordinary sights. The claim is the improved construction of instrument for adjusting and correcting deviations in the mariner's compass.

1958. IMPROVEMENTS IN TELEPHONIC EXCHANGE SYSTEMS.—*By John Henry Johnson.*—(*A communication by George Lee Anders, of Boston, and Thomas Augustus Watson, of Everett, in the State of Massachusetts, United States of America.*)

In this system there are a series of telephonic circuits radiating from a central station, and on each circuit any number of stations, each station being provided with an apparatus, which, when communication is desired with a station, will give an audible signal at that station only. At the central station there is a switch-board for connecting one circuit with another, and for connecting the signalling apparatus to any circuit, and there are signalling apparatus for controlling the number and character of the electric impulses to determine an audible signal at any desired station and signals at the other stations on the same circuit that the line is in use, and at each station there are switching devices for securing secresy, whereby when any two stations are communicating telephonically no other station on the same circuit can overhear what is being said, and means for signalling the operator at the central station without signalling any other station on the same circuit. Upon each of the circuits is a different form of individual signal bell, each of which is fully described. The switch board at the central station is adapted for connecting each of the several circuits with the telephones, keys, and signalling apparatus at the said station, and for connecting any two or more of the several circuits together. It consists of a suitable frame supporting a series of upright metallic bars which are insulated from each other, and are connected respectively to the several circuits, with the exception of one at either end of the series, which one is connected to the switch, and thus to the telephones and signalling apparatus at the central station. Immediately behind the upright bars and at right angles to them is a series of parallel horizontal metallic rods, also insulated from each other, which serve to electrically connect two or more of the upright bars together by means of metallic connectors, which connectors can be slid on the upright bars, and when released spring into contact with the connecting rods. Each of these sliding connectors rests normally upon a short metallic bar which is connected to the electro magnet of a suitable annunciator, which lets fall a number plate when the electro magnet of the annunciator is excited or otherwise gives a signal, and from said electro magnet connection is made with the earth. It is desirable in a telephone exchange system to provide means whereby when persons at any two stations are communicating with one another telephonically a person at any other station is prevented from overhearing the conversation without notifying the stations talking with one another. This result is accomplished by means of a secresy switch, which in this system is placed at each station. When a telephone is used with a secresy switch a circuit normally passes through the signal bell at each station to the next station, and the telephone when not in use is not in circuit; but when it is desired to communicate by telephone with a station on either side, the line entering the station

1958

FIG. 1

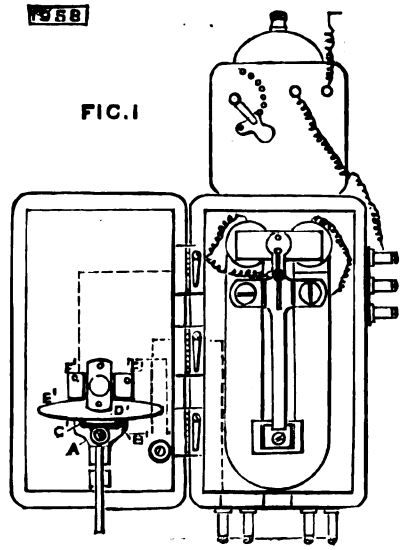
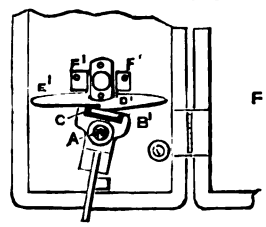


FIG. 2

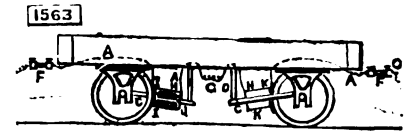


on that side must be connected to earth through the telephone. If, then, while two stations thus each having their respective telephones put to earth are communicating with one another the telephone at an intermediate station is put to earth, notice will be given at each of the other two stations by the interruption of the communication. The switch which is used with this system is attached to the hook or other support upon which the telephone is placed when not in use, and is moved to one side or the other to establish connection with "line in" or "line out," as may be desired, and when the telephone is replaced upon its support, automatically returns to its original position, but differs from and is an improvement upon the switches of this kind heretofore used in that all the electrical contacts are effected by the action of springs, or their equivalents, which act upon opposite sides of the switch lever to restore the latter to its normal position, in which "line in" and "line out" are connected, in that said lever is held in position by means of a latch when the lever has been moved by hand to one side or the other to establish an earth connection through the telephone with "line in" or "line out," and in that the replacement of the telephone upon its support effects the release of the switch from the latch, so that it is returned to its normal position by the action of the springs or their equivalents. A switch constructed according to this principle is represented in the drawings, which show the apparatus at a station, viz., the individual signal bell, the magneto induction apparatus for signalling the central station, and the secresy switch, as arranged and combined together in a compact form in a suitable box or case. In these drawings Fig. 1 shows the switch in elevation; Fig. 2 shows the switch in section. The switch is shown as attached to the cover of the wooden box which contains the magneto indication signalling apparatus, but it may be otherwise situated, as may be found convenient. It consists of a T shaped metallic lever A, which is pivoted to the wooden cover B^1, and is provided with vertical projections or lugs on each side. A block of some suitable insulating material C^1 is attached to the lever A between the projections, and to the upper surface of this block is attached a plate of metal D^1, the surface of which rises above the projections b^1 b^1, and which plate is shorter than the space between these projections, and therefore does not touch the same; E^1 E^1, are two U shaped horizontal springs placed opposite to each other and having their bent portions turned in opposite directions, and F^1 F^1, are two plates of metal suitably fixed to the wooden cover B^1 side by side, but insulated from each other, and of these metal plates that upon the left hand, when the cover B^1 is turned back, is connected to "line in," and that upon the right to "line out," as shown in figure. Each of the springs E^1 E^1 is secured by one end to one of these metallic plates respectively, and the other and free ends of these springs bear upon the face of the metal plate D^1, and consequently when the lever A is in its normal position, as shown in Fig. 1, the circuit is completed through these springs and the plate D^1, but when the lever is turned to either one side or the other one of the projections makes contact with one of the springs and lifts its end from the plate, as shown in figure, thereby breaking the electric connection with the other spring and establishing an electrical connection with the lever A.

1563. RAILWAY BREAKS.—*J. H. Johnson.*—*Dated 16th April*, 1880.—(*A communication.*) 6*d.*

This consists in the application of electricity to the wheels of railway rolling stock as a break power. A is an electric wire proceeding from a battery and a machine, and connected to electro-magnets contained in a case, H, and shod with iron shoes, I, made to fit the periphery of the wheel. J is a regulating screw, and K are studs on each side for supporting the case H on an arm,

1563



C, which is supported at one end by a pendant lever, D, and at the other end by a stud on a bracket descending from the framing of the carriage; F F are connections of the ordinary description for joining the wires between each carriage, and G G are curls in the wires, so as to allow of any stretching that may be found necessary or convenient.

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TELEGRAPH SHIP FURNISHERS, FOR ENGINEERS', CARPENTERS', STEWARDS', DECK STORES &c.

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Patent Ventilators.
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Ships' Pumps and Closets.
Side Scuttles and General Brass and Copper Work.

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Ships' Cooking Hearths.
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LIGHTNING CONDUCTORS:

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By RICHARD ANDERSON, F.C.S., F.G.S., Member of the Society of Telegraph Engineers; Assoc.Inst.C.E.

WITH NUMEROUS ILLUSTRATIONS.

LONDON: E. and F. N. SPON, 46, Charing Cross. NEW YORK: 446, Broome Street. 1880.

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Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
Letters of Credit and Circular Notes issued.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

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A Pamphlet, with full particulars, on application.
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NOTICE OF REMOVAL.

EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
3, BEDFORD COURT, COVENT GARDEN, W.C.,
Will on and after the 1st May, 1880, REMOVE to
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C
The Gower-Bell Loud Speaking Telephone.
TELEPHONE LINES ERECTED and MAINTAINED.
EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.
Catalogue of Electric Signals, with 156 Illustrations, post free six stamps.

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Proprietors of the Gramme Patent Machine for alternate currents.
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SLIP

American Bell Telephone Company.—This company has just declared its first dividend of 3 per cent.

Telephone in Prussia.—The first public telephone was laid down by the Berlin Telegraph Office on the 22nd ult.

Underground Wires.—The American Union Company is about to lay experimental underground wires in Philadelphia.

Western Union Telegraph Company.—This company has recommended a dividend of 1½ per cent. for the current quarter.

The Congress of Electricians.—The Prince of Wales is spoken of as the probable president of the Congress of Electricians and of the Electrical Exhibition.

South Kensington Museum.—The South Court was on Boxing Day lighted by electricity. The six o'clock return of the day gave 21,581 visitors as having entered the museum and galleries.

East Indian Railway.—The report of the directors states that the electric telegraph earnings for the half year ended June 30, 1879, were £2,656, and for the corresponding half year in 1880, £2,659, or an increase of £3.

Transvaal.—The telegraph wires beyond Heidelberg have been cut by the Boers. Mr. Ilbery, the inspector of telegraphs for that district, made his escape, and returned to Standerton. The two Murrays were taken prisoners.

Heliographic.—A number of the heliographs lately brought back by troops from South Africa will be sent out at once to the Transvaal; also some improved signalling apparatus, and a number of skilled mounted and dismounted signalmen.

Society of Telegraph Engineers.—The name of Mr. Edward B. Bright was accidentally omitted from the list of the newly elected members of the Council of the Society of Telegraph Engineers, published in *The Electrician* of the 25th December.

Light and Sweetness.—We understand that the British Electric Light Company (Limited) has been selected by the management of the Seafield Hydropathic Establishment, near Waterloo, for the lighting up of that important institution. This fact will be regarded as an evidence of the confidence already bestowed on a company so recently formed.

The Electric Light at the Liverpool Docks.—At the last meeting of the Mersey Docks and Harbour Board, it was resolved to adopt the electric light at a portion of the new dock system at the north end of the city, at an estimated cost of £2,000. This is to be an experiment, and upon the result will depend the extension of the light over the docks generally.

Snowstorms in Scotland.—Boisterous weather has prevailed in the north and west of Scotland during the past week, and on Monday last, after a severe gale and snowstorm, only two telegraph wires out of the Glasgow office were left intact. On the Highland Railway the snow in some parts lies as deep as 12 feet, and the Callander and Oban Railway has been blocked.

An Electric Watch.—A watchmaker at Copenhagen, of the name of Sonderburg, is reported to have made a watch which requires no winding up, inasmuch as it performs that work itself by means of an electric current. An electro-magnet fixed inside the watch keeps the spring perpetually in a state of tension. All that is required to keep the watch going is to preserve the battery in proper working order, for which purpose one or two inspections in a twelvemonth are said to be sufficient.

Edison.—Our comic American contemporary, *Puck*, quotes the following from the *S. F. News Letter*:—"Edison, the newspaper electrician, is at it again. This time he announces that he has hit the nail on the head, and the consequence will be a brilliant illumination of the entire earth at a cost not worth mentioning. As a means of producing the incandescence, he uses infinitesimal shreds of bamboo, procured at a great expense from Cuba. This new light should be patented under the title of "Edison's Electric Bamboozler."

Electric Lighting and Street Traffic.—The other evening a hansom cab knocked down and severely injured a foot passenger in Liverpool-street, London, and the driver, as usual, made off as quickly as his horse would take him. A police constable, however, pursued him for a short distance, and, facing the station, where the electric light brightly illuminates the street, was able to take the number of the offending vehicle. Cabby has consequently been summoned —much to his surprise, no doubt, and much, we hope, to the edification of his brethren, whose reckless careers would be speedily checked were electric lighting more general.

Swan's Light.—At the *soirée* of the Associated Societies at Liverpool last week Mr. Swan described his new incandescent electric light, which he hoped would before long be brought into domestic use as well as into places of business. He said the light was steady and mild, and could be easily divided, in proof of which he gave illustrations in St. George's Hall. The carbon is entirely secluded from contact with the air, and the lamps were so simple that if broken a servant could replace them. He also exhibited an electric safety lamp for use in mines, which was of such strength that before it could be broken by a blow the light would be put out. It was movable, and was incapable of causing explosion.

The Telephone Company and the Post Office.—The counterblast in response to the advertisement of the Postmaster-General was evidently sounded in ignorance of what form of instrument he intended to adopt. Our intimation that 20,000 Gower-Bell telephones had been ordered by the Government was apparently a complete surprise, for there are rumours now afloat that the Company is anxious to come to terms with the Post Office. We sincerely hope that this may be the case. Meanwhile, we cannot help saying that the Company's threat was most ill advised. It virtually told the public that the Company aimed at a monopoly for itself, though professing to attack monopoly in the hands of the Post Office.

Lecture Diagrams.—Messrs. W. and A. K. Johnston have published an admirable series of coloured lecture diagrams designed by W. Lees, M.A., lecturer on natural philosophy, Edinburgh. These diagrams will illustrate lectures covering a fairly wide field, as they have been judiciously designed. In sheet 4, for example, we have a "section of a battery," a "telegraph circuit," the "front of a needle instrument," the "internal works of the instrument," a "sending key," a "sounder," an "electric bell," &c., the various parts in each case being clearly shown. Handbooks to accompany the diagrams are also published containing in a compendious form the basis of lectures. We congratulate the publishers in producing such good work, even when we remember that they are noted for good work.

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EDISONIA.—The Edison Electric Light Company have levied an assessment on their stockholders of 60 dollars (£12) per share. The capital of the company is 300,000 dollars (£60,000), which has been used for experiments. Besides this a considerable sum has been borrowed; and the assessment is to pay this borrowed capital, and afford the means for further experiments. *A propos* of this subject, I may mention that the Edison light is still imperfect. It seems that the carbon loop is again the weak point, the material of which it is made being unsatisfactory. To overcome this trouble it is said that Mr. Edison has employed Mr. Branner—a gentleman who has travelled considerably in South America—to search through Brazil to find some species of fibreless palm, of which it is proposed to make the loops. Mr. Branner expects to be absent a year.—*Gas Journal.*

A COMIC VIEW OF THE TELEPHONE JUDGMENT.—For once in a way *Punch* is comic in spite of itself. Under the heading of "Good-bye, Telephone!" it prints the following:—"The Law has spoken, and the telephone is told to leave a country which is tied hand-and-foot to the telegraph. The ten millions of public money poured into the pockets of stock-jobbers in 1869 has bound England to the telegraph and the telegraph to England for ever. We may read about scientific progress, but we must go abroad to see it. The wire that misspells a message, and the street Arab who delivers it at his leisure, are all we shall get in this country till the day when we are conquered by the Irish." As a concentrated essence of nonsense and misrepresentation this is superb. We are not quite sure about it, but we suppose it is to be taken as a satire upon the wrong-headed lamentations of the daily newspapers—which are truly laughable because laughably untrue.

INTERNATIONAL ELECTRICAL EXHIBITION.—"The objects admitted," says the Paris correspondent of the *Daily Telegraph*, "will comprise all kinds of apparatus for the production and transmission of electricity, and every description of work to which this potent force is applied. There will also be what is called a retrospective collection of apparatus, concerning the first experiences and oldest applications of electricity, and of a library of works on the science as applied to industry. Objects sent for exhibition will be received at the Palais de l'Industrie, which is lent by the Government, on and after July 1 next. The exhibition is to last from Aug. 1 to Nov. 15, and the International Congress is to be opened on Sept. 15, presided over by the French Postmaster-General, who, as you know, is also Minister of Telegraphs. The Congress is to be held at the Trocadero Palace, and the Exhibition at the Palais de l'Industrie is to be open by night as well as by day. All communications are to be addressed to M. Berger, Numero Quartres, Palais des Champs Elysées.'

KELSO.—A correspondent of a contemporary devoted to gas interests, discussing the rumour that Kelso is to be lighted by electricity, says:—"It is stated that the town of Kelso was one of the first places in Scotland to introduce the system of lighting by gas, and acting on the belief that it is as well adapted as ever to become a pioneer in progress, there are some people who think it ought to be among the first provincial towns in Scotland to be lighted by electricity. The Police Commissioners are urged to think over the matter seriously, and to open communication at once with Mr. Swan, of Newcastle, with the view of arranging with him to light the streets of the town by his system, which, it is said, makes lighting by electricity much more economical than the methods previously in use. Persons who talk in this way either do not know or ignore the fact that the Burgh Police Commissioners in Scotland have no power to use burgh rates for public lighting in the way suggested, even though it were proved that electric lighting were as economical and efficient as lighting by gas.

ELECTRIC LIGHT EXPERIMENTS IN NEW YORK.—The correspondent of the *Daily News*, telegraphing from New York last Tuesday, says:—The experiment of lighting Broadway with the Brush electric light last night is regarded as entirely successful. The distance lighted was about half a mile. There were 15 lamps, each of 2,000 candles power, 262 feet apart, connected by 10,000 feet of wire, and supplied by a dynamo-electric machine of 100 horse-power, only 14 horse-power being used. Midway between the posts small type in a newspaper could be read. The light was remarkable for steadiness. The gas flames burning at the same time cast shadows. Each electric lamp is fitted with double carbon pencils, so arranged that when one set of carbons is consumed the second set is automatically switched into the circuit without interruption to the light. The lamps burn for 16 hours unattended. The experiment will be continued for a month. No estimate of the expense is given yet. Mr. Edison has municipal permission to light a second district of the city with his light which he exhibited last night. Each lamp is of 16 candle-power, and gives a steady yellowish light.

THE CROMPTON LAMP AT THE GLASGOW POST OFFICE.—This light has been successfully applied in the instrument and sorting rooms, and unbiased observers testify to its excellence. The apparatus includes a new portable engine, made specially for electric lighting purposes, by Messrs. Marshall, Sons and Co., Gainsborough; four Gramme dynamo electric machines of the "A" pattern, all fixed on a tumbril in the rear of the engine and driven by belts from its two fly-wheels; and a corresponding number of Crompton's electric lamps in their containing glass lanterns, and connected with the dynamo-machines by the conducting cables. Both the apartments lighted electrically are very spacious, and, therefore, the two lamps used in each of them have been placed at as high an elevation as possible, consistent with the non-production of interfering shadows from the beams, girders, tie-rods, &c., of each of the roofs. The containing lanterns used in the sorting room are large inverted glass bells, frosted over most of their internal surface, so as to soften and diffuse the light in the greatest possible degree.

LIGHTING THE HOUSE OF COMMONS.—The Brush light illumines one face of the clock. Why, say its exponents, should it not illumine the House of Commons itself? Experiments with this object in view have been made by the Brush Company. The House itself will have to decide as to the adoption of the electric light, and the relegation of gas to minor parts of the building. As the *Daily News* says:—"Both the Speaker and the Commissioner of Works have declined to assume the authority even of sanctioning an experiment whilst the House is sitting. What will doubtless happen is that, on the motion of an hon. member, made early in the session, it will be ordered that experiments should be made (probably during the Easter recess) at which the practicability of the light may be determined. No very great expense will be involved, at least on behalf of the nation. The proprietors of the light are naturally anxious that it should receive the most public test, and none better can be conceived than an attempt to light the House of Commons." We might suggest that "testing" has little to do with such anxiety; but probably the proprietors look upon any such expenditure as the cheapest and best possible advertisement.

TELEGRAPH CLERKS' GRIEVANCES.—A provincial con-

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temporary states that a general petition from telegraph clerks to be submitted to the Postmaster-General will embody a request for the introduction into the service of the following reforms:—"Firstly, that classification be entirely abolished; secondly, that the salary on entering the service commence at 16s. per week, rising uninterruptedly by annual increments of 2s. per week to £200 per annum; thirdly, that all the overtime be paid at the full rate of pay, reckoning six days per week without reduction for any partial holiday; fourthly, that all Sunday duty be paid for at the ordinary overtime rates; fifthly, that seven hours be considered a night's work, any time worked beyond that to be paid for as overtime, duties after midnight to be considered as nightwork; sixthly, that eight hours constitute a day's duty, to be performed without break, abolishing split or divided attendances; seventhly, that three weeks' annual leave of absence be granted to all clerks receiving 16s. to 40s. per week, and one calendar month to those receiving more than that amount; and, eighthly, that those officers who are called upon to perform supervising duties shall receive 'duty-pay' based upon the recommendations of the Playfair Commission."—Later information states that the Postmaster-General has declined to receive a deputation of telegraph clerks who wished to lay their grievances before him.

THE PRESS AND THE TELEPHONE DISPUTE.—The *Examiner* points out some of the advantages which the public will derive from the telephonic systems virtually falling into the hands of the Postmaster-General. "The instruments," says our contemporary, "actually provided by the companies are not the best that could be devised, while the indiscriminate erection of overhead-wires is becoming a public danger. Moreover, had the existing companies obtained a legal recognition outside the Acts of Parliament, a host of fresh companies would undoubtedly have sprung up, and the country would again have had to face those very evils, both of competition and of combination, which were supposed to have been got rid of for ever when the acquisition of the telegraphs was effected ten years ago. Added to this, there would have resulted a formidable loss to the public revenue had the railway companies and other owners of telegraph wires become entitled to carry public telegrams by the mere substitution of telephones for the instruments commonly in use. Both in regard to the stability, route, and insulation of the wires, as well as to the pattern of the telephones, a public department will be trammeled by none of those considerations of economy and favourite patents which necessarily limit the usefulness of private enterprise. Again, the customer will secure the guarantee, which at present he has not, that his messages will not be disclosed by the servants of the company, and that no undue preference be given one customer over another. The public are now informed that the Post Office is prepared to put its customers in telephonic communication with each other in any manner they please—prepared to do in fact all that the telephone companies have been trying to do independently for eighteen months past. This resolution will remove any remaining impression that the authorities were seeking to deprive the public of a very convenient means of communication. As to the existing companies, their sphere of operations will probably be diminished; but on the other hand they may congratulate themselves that their continued existence can be purchased at the cost of a license, and that they have not been summarily suppressed—a fate that has befallen several similar schemes on the Continent."

SUGGESTIONS ON THE ART OF SIGNALLING. BY ALEXANDER MACFARLANE, M.A., D.Sc., F.R.S.E.—After considering the analogy which exists between the arts of writing and of signalling, the author proceeded to discuss what alphabet is the most suitable where the physical agent is not electricity. If we choose for elementary signals two qualities of the agent of communication A and B, which can be produced independently of one another, then the agent can be put into four states, viz., 1st, having the quality A, but not the quality B; 2nd, having the quality B, but not the quality A; 3rd, having both the qualities A and B; 4th, having neither of the qualities A and B. One of these states is required to separate letter from letter, and word from word the fourth state where the agent is undifferentiated is the one naturally adapted for the purpose. From the remaining three states we can get 3 permutations of one signal, 9 permutations of two signals, 27 permutations of three signals. Without going to a higher permutation than that of three signals, we get 39 symbols (three of these would probably require to be omitted as repeating the same signal three times) which are sufficient for the numerals and all the letters contained in the Morse alphabet, less by one. These symbols, we suppose assigned to the letters according to their frequency of occurrence as given in that alphabet. In the case of the Morse system we have only three states of the agent; the third of the above states is not, or cannot be, made use of. As one is required for the purpose of spacing, only two are left to form symbols. To form equivalents for the 39 symbols spoken of above, it requires 2 permutations of one signal, 4 permutations of two signals, 8 permutations of three, 15 of four, and 10 of five. Thus in the former case 102 signals are required to form the alphabet, in the latter 144. If the elementary signals of the Morse system are made to depend on a difference in quantity, then the above qualitative system possesses other two advantages. Its signals, as they differ in quality, can each be made to occupy the minimum time necessary for a signal to be observed, whereas in the other case the longer signal occupies thrice the time of the shorter; secondly, elementary signals differing in quantity require, though belonging to the same letter, to be separated by an interval, whereas those differing in quality do not. By assuming that each of the qualitative signals can be sent in the same period of time as the short signals, also that the time required in the Morse quantitive system for the space between the elements of a letter is equal to that period, and the time required for a space between the letters to thrice that period, I have been able to calculate the relative times required by the two systems to signal the words London, Edinburgh, Dublin. The respective ratios are 2·8, 2·6, and 2·9. We may therefore conclude, assuming that the other advantages and disadvantages neutralise one another, that a message can be signalled 2·6 times as quick by the qualitative alphabet described as by the Morse (quantitative) alphabet. The four-state alphabet would allow one elementary sign to be invariably associated with the right hand, and the other elementary sign with the left hand, and the compound elementary sign with both together. The effect of this would be that a person who had learned to signal by means of any one agent, would have almost equal facility in signalling with any other. The author then proceeded to offer some suggestions as to how this alphabet could be applied in the respective cases of signalling by means of the heliograph, the light of a lighthouse, steam-whistles, flags, and touch; and advocated the opinion first brought forward by Dr. J. A. Russell in a paper read before the Royal Scottish Society of Arts in 1875, that signalling should be taught in the primary schools.—*Abstract from the Proceedings of the Royal Society of Edinburgh.*

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THE QUESTION OF THE PRESENT POSTAL TELEGRAPH TARIFF.*

BY R. PRICE WILLIAMS, M.I.C.E.

The practical working of the electric telegraph for commercial purposes may be said to date from 1838, when Messrs. Cook and Wheatstone, after having in the previous year patented their magnetic needle telegraph, put up the first telegraph line on the Great Western Railway between Paddington and West Drayton; this was followed by the construction of a telegraph on the Blackwall line in 1840, and by another in Glasgow in the following year. It is not a little remarkable that for some considerable time subsequent to the invention and construction of the electric telegraph its use was almost exclusively confined to railway purposes and train signalling, the idea of its commercial value being so little appreciated by the public at that time that the Electric Telegraph Company, on its establishment, after purchasing Messrs. Cook and Wheatstone's inventions in 1846, was looked upon as a complete commercial failure, the shares for a long time being considered as almost valueless, the chief source of the telegraph company's revenue then being derived from contracts they managed to obtain from the railway companies for the construction and maintenance of railway telegraphs. Fortunately, however, for themselves, the Electric Telegraph Company, foreseeing the future commercial value of their undertaking, at the same time that they succeeded in obtaining from the railway companies highly advantageous contracts for the construction and maintenenance of the railway telegraphs, secured in many cases by way of set off for the use of their patents, and for other services, exclusive way leave rights for their own telegraphs over the respective railway companies' lines.

From 1846 to 1851 very great improvements were made in the working of the telegraphs, and in November of the latter year a cable was successfully laid between Dover and Calais, and for the first time the prices of the funds in Paris were known the same day within business hours on the London Stock Exchange.

The commercial value of the telegraph undertakings now began to become more generally recognised, and from the period of the laying of the first submarine cable in 1851 may be dated the formation of the other great telegraph company, the Magnetic Telegraph Company, which, in close relationship with the Submarine Telegraph Company, enjoyed the exclusive right to carry messages for that company, with exclusive concessions of telegraphic communications from the French and Belgian Governments. This company, which in 1856 became amalgamated with the British Telegraph Company, under the title of the British and Irish Magnetic Telegraph Company, was obliged, owing to the fact of the Electric Company having already acquired exclusive way leave rights on the railways, to have recourse to the highways and canals, in order to establish its communications with the principal towns in this country. In Ireland, however, the case was different, the Magnetic Company having, at a very early period of its existence, obtained there almost exclusive possession of the railways, the Electric Company being obliged in that case to betake itself to the highways and canals. So profitable were telegraph undertakings now becoming that other companies, such as the United Kingdom and London District Telegraph Companies, were formed, the former company having been established in 1861, with the declared object of establishing a cheap and uniform 1s. charge throughout the country, irrespective of distance. Another feature in this undertaking was its issuing perpetual 7½ per cent. bonds, upon which interest was to be paid by means of the issue of frank telegraph message stamps, these frank stamps being used very much as postal telegraph and postal stamps are at present. The London District Company, which began its career in 1860, was also formed with the object of establishing cheap telegraph communication within the area of the metropolis and the suburbs, the company's tariff in 1860 being as follows:—4d. for a message of ten words, and 6d. for a message of twenty words, and for a message of ten words, including an answer of similar length, 6d., these charges being in all cases inclusive of delivery. The following summary affords some idea of the progress of this company's traffic since its formation in 1860 to 1866:—

Year.	Number of Messages.	Percentage of Increase.	Number of Stations Opened.	Miles of Line.
1860	74,582	—	52	335
1861	144,022	93·10	77	378
1862	243,849	69·32	84	401
1863	247,606	1·54	81	430
1864	308,032	24·40	80	454
1865	316,272	2·68	83	470
1866	214,496	-32·18	80	495

* Read before the Statistical Society, 21st December, 1880.

Although it cannot be said that either the United Kingdom or London Provincial Telegraph Companies, at the time of their acquirement by the Post Office, had become commercially as successful as the other two great telegraph companies, the reduction to the uniform 1s. rate, effected in the case of the United Kingdom Company, and to the low local 6d. tariff of the London Provincial Company, at once resulted in the other companies reducing their tariffs, and the impetus thereby given to the development of telegraph traffic generally throughout the kingdom was very remarkable.

The continuous reductions in the tariff of the Electric and International Telegraph Company during the seventeen years preceding its acquirement by the Post Office, is shown to have been in every case followed by an immediate and rapid increase in the number of messages. In 1840, and for some years after its formation, the Electric Company's charges for a message of twenty words were at the rate of 1d. per mile for a distance of 50 miles, ½d. a mile for 100 miles, and ¼d. per mile for all distances beyond, the words in the addresses being also charged for. In 1850 this company's maximum charge for twenty words was reduced to 10s., and in 1851 it was further reduced to 8s. 6d., and in November of the same year the charge for 100 miles was reduced to 2s. 6d., and for distances over 100 miles to 5s. The average receipts in this year, however, still amounted to as much as 10s. 0½d. per message. In 1854 various reductions in this company's tariff were made, the charge for the addresses being for the first time discontinued, practically lengthening each message to thirty words. The average receipts per message for this year show a reduction of nearly 50 per cent. (49·14 per cent.) over the preceding year, while the number of messages were considerably more than doubled (132·98 per cent. increase). In 1855 the company's tariff for messages of twenty words was as follows:—

		s.	d.	
For distances of	50 miles.....	1	6	for twenty words.
,,	100 ,, ...	2	0	,,
,,	150 ,, ...	3	0	,,
,, beyond	150 ,, ...	4	0	,,

the average receipts per message being reduced to 3s. 10¾d., while the increase in the number of messages in the year amounted to over 33 per cent. In 1861, when the London Provincial Telegraph Company had commenced business with its 6d. messages, the Electric and Magnetic Telegraph Companies were both obliged to reduce their charges for all London messages, and this was speedily followed—when the United Kingdom Company commenced its operations—by a uniform 1s. rate for all messages forwarded short distances, the average receipts per message being reduced to 3s. 6¾d. In 1862 the Electric Company's tariff was further reduced as follows:—

		s.	d.	
For distances of	25 miles...	1	0	per message of twenty words.
,,	50 ,, ...	1	6	,, ,,
,,	100 ,, ...	2	0	,, ,,
,,	200 ,, ...	2	6	,, ,,
,,	300 ,, ...	4	0	,, ,,
,,	400 ,, ...	5	0	,, ,,

The average receipts per message amounted to 2s. 10½d., being a reduction of nearly 20 per cent. below the previous year's average; these reductions being accompanied at the same time by an increase of nearly 28 per cent. (27·72 per cent.) in the number of messages sent during the year. In 1864 another considerable reduction in this telegraph company's tariff occurred as follows:—

		s.	d.	
For distances of	50 miles ...	1	0	per message of twenty words.
,,	100 ,, ...	2	0	,, ,,
,,	200 ,, ...	2	6	,, ,,
,,	300 ,, ...	3	0	,, ,,

the average receipts being further lowered to 2s. 4¼d. per message, equivalent to a reduction of over 15 per cent. on the preceding year's average, while the year's increase in the number of messages amounted to over 29 per cent. In 1865 the tariffs of the Electric and the other telegraph companies were again very considerably reduced, but from that date they continued unaltered down to the period of the acquirement of the telegraphs by the Post Office on the 6th February, 1870. The rates charged were as follow:—

		s.	d.	
For messages within London and other towns		0	6	for twenty words.
For distances of	100 miles	1	0	,,
,,	200 ,, ...	1	6	,,
,,	300 ,, ...	2	0	,,

The average receipts per message for that year amounted to only 2s. 1½d., while the year's increase on messages was as much

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as 26·09 per cent. The chief feature in the reductions in this year's tariff was the resumption of the 6d. messages within the metropolitan area and at all the principal towns. To this important reduction must be ascribed the large increase which followed in the number of messages. Altogether during the ten years 1857-67, the Electric Company's average receipts per message were reduced from 4s. 1¼d. to 2s. 0¾d., or just 50 per cent., while the number of messages in the same period increased from 881,271 to 3,351,910, or nearly fourfold.

Postal Telegraphs.

The ten years' experience we now have of the working of the postal telegraph system, with its reduced and uniform 1s. charge for all messages not exceeding twenty words, appears fully to justify the efforts recently made to obtain some further reduction in the postal telegraph tariff, and notwithstanding what the Postmaster-General, in his reply to the deputation which recently waited upon him, said, in regard to the present state of the revenue not admitting of any immediate reduction, the writer is of opinion that the result of the further inquiries he is at present understood to be making in regard to this important matter will be such as to satisfy him that the time has arrived for some large and well-considered scheme for a further reduction in the tariff, and that the loss of revenue anticipated to result therefrom will prove to be even at the outset scarcely appreciable, while the stimulus afforded in increasing and developing new sources of telegraph traffic would, as the past experience of the telegraph companies shows, be such as materially to reduce the present very heavy percentage of the working expenses of the department.

Attention has already been drawn to the very large increase in telegraph traffic which resulted from the repeated and almost continuous reduction in the tariffs of the late telegraph companies, the effect in reducing the working expenses of those companies being still greater, as is well known to those acquainted with the history of these undertakings. By way of illustration it may be mentioned, that while in 1859 the Electric Telegraph Company's average receipts were 3s. 11¼d., the working expenses amounted to as much as 2s. 7d. per message, or over 65 per cent., whereas in 1869, when the average receipts had become reduced to 2s. per message, the working expenses only amounted to 1s. 0¼d. per message, or 51 per cent. of the gross receipts. In other words, while the average receipts per message had been reduced 49 per cent., the reduction in the working expenses exceed 60 per cent.

Frequent and considerable as were the reductions effected at various times in the message tariffs of the different telegraph companies, there never was anything which in magnitude and importance approached that effected on the acquirement of the telegraphs by the Post Office, when under Mr. Scudamore's auspices the present uniform 1s. message rate was adopted. In order fully to realize the extent of this reduction, it is only necessary to bear in mind that, whereas in 1869 the average receipts of the late Electric Telegraph Company, as already shown, amounted to 2s. per message, the average receipts per message during the year 1872 was only 1s. 1d., the reduction amounting to nearly 46 per cent., the increase in the number of messages resulting from this large reduction having amounted to at least 46 per cent. during the first year, and to 26, 25 and 24 per cent. respectively in each of the three following years, while the total number of postal telegraph messages have increased during the last nine years from 9,850,177 to 26,547,137, or 271 per cent., nearly threefold the average rate of increase during that period, amounting to over 10½ per cent. per annum. It is difficult to determine accurately the total number of messages sent by the telegraph companies in 1869, the year immediately preceding their acquirement by the Post Office, but at the outside they could not have exceeded 6¾ millions, in which case the increase in the number of messages during the last ten years has just been fourfold.

The reason why this large increase in the number of messages has not as yet been accompanied by a corresponding reduction in the working expenses per message, as invariably resulted in the case of any considerable reduction in the tariffs of the telegraph companies, is well known to those acquainted with the history of the acquirement of those undertakings by the Post Office.

It is unnecessary here to say anything on this subject beyond remarking that the causes which have so far operated against a reduction in the working expenses are of an exceptional character and not likely to recur. The new telegraph lines and wires which Mr. Scudamore was obliged to construct, without much regard to "ways and means," in order to prevent an utter and disastrous breakdown of the telegraph service at a most critical juncture have now been completed and paid for.

The total gross receipts from telegraph messages in the year ending 31st March, 1880, after deducting the receipts from press messages and moneys paid out, were £1,285,627, and the total number of messages forwarded, exclusive of press messages, was 24,467,771, the average receipts per message being 1s. 0·61d.

Had all these messages been ordinary 1s. messages of twenty words, they would have yielded a revenue of £1,223,387, the balance of £62,240 representing the excess money received for all messages over twenty words. Assuming this latter amount to be divided equally between messages of twenty, thirty, thirty-five, and forty words, for which excess payment is now required of 3d., 6d., 9d., and 1s. respectively, the number of messages of each kind exceeding twenty words would be inversely proportioned to the excess charges as follows :—

Messages exceeding 20 words.		Receipts from messages of more than 20 words.
	Equivalent to—	£
1,244,780	Messages of 25 words at 3d.	15,560
622,390	,, 30 ,, 6	15,560
414,927	,, 35 ,, 9	15,560
311,195	,, 40 ,, 1s.	15,560
2,593,292		62,240

Hence the total number of messages exceeding twenty words would be 2,593,292, which, deducted from the total 24,467,771 messages forwarded, would leave 21,874,479 1s. messages of twenty words and under.

Of these 21,874,479 1s. messages, all we know is that they did not exceed twenty words, no means being afforded to the public of classifying them; and as no restriction was put upon their inserting less than the twenty words, the probability is that this number of words was in the majority of cases approached very nearly.

Reverting again to the 21,874,479 1s. messages of twenty words and under, it is reasonable to suppose that, as in the case of messages in excess of twenty words, the numbers of those of five, ten, fifteen, twenty words respectively would, if the cost varied, be inversely proportional to the number of words in each case. That 40 per cent. of them, for instance, might have been condensed to five words, 30 per cent. to ten words, and 20 per cent. to fifteen words, leaving 10 per cent. for messages of the full amount of twenty words.

On the assumption made, that the average number of words requisite for ordinary addresses is fifteen, the proportionate charge for the address itself, in the case of 1s. message of twenty words (*i.e.* thirty-five words, including the address), would be three-sevenths of a shilling, or 5·143d., equivalent to about one-third of a penny (0·343d.) per word, and the charge for the first five words of a message, including the addresses, would be four-sevenths of a shilling, or 6·857d.; the charge for ten words would similarly be five-sevenths of a shilling, or 8·571d.; the average for fifteen words six-sevenths of a shilling, or 10·285d.; the charge for twenty words being, of course, the full shilling. The reduced tariff suggested by the writer as best calculated to meet the requirements at the present juncture is based on a consideration of the foregoing analysis of the existing charges, and would be as follows:—6d. for a telegram of twenty words, including the addresses of sender and receiver, and 2d. for each additional five words. The system of including the addresses in the number of words allowed obtains, as is well known, in the case of continental messages, and its advantages are manifold and obvious. In the first place, it reduces the amount of work by offering a direct pecuniary inducement to shorten the number of words in the address. It further makes the payment (as it ought to be) proportionate to the amount of work done, as measured by the number of words in the telegram. It also offers an additional advantage to those who choose to avail themselves of the system of registering their names at the post office in the town where they reside, of still further condensing the words in the address, and thereby proportionably increasing the number of words in the message.

In conclusion, the writer observed that the total amount of capital expended by the Post Office in the acquirement of the telegraph amounts to 10,120,075, and the question of providing a sinking fund to recoup this large amount is one, in his opinion, well deserving of attention in any scheme for the reduction of the existing postal telegraph tariff; and, as bearing upon this question, it may be mentioned that the annual sum necessary to recoup this capital in a period of forty years would only amount, at 3½ per cent., to what would be equivalent to a charge of just 1d. (1·0821d.) a message on the 26,547,137 messages of all kinds which were forwarded by the Post Office during the last year.

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THE ELECTRICIAN.

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1880.

Our greeting on the first morning of the new year must be to each and all of our readers, we wish it may prove to them a happy and prosperous year. The revival of confidence in commercial circles foreshadowed at the close of 1879 has increased, as may be seen by those who watch the trade and finance of the country. There seems to be no lack of money, and what is better still no desire to hoard it or refuse it when sound undertakings are in question. During the last quarter of 1880 a very large number of companies have been registered, many of these with objects in view, the financial result of which promises a moderate return. These, so far as we can gather, have been fairly supported. There are others, however, of a more or less speculative character, into which some honest but ignorant shareholders have been inveigled, to find ultimately that promises may be at once fair and faithless. A few short years ago, and men's hearts failed them. Money was plentiful, but those who held it determined still to hold, and speculation suffered. The same cycle of operations seems to be inevitable; dear money, little speculation, recuperation, and finally plunging. There is room and work in the world for the investment of all the spare capital at a moderate interest, but the desire to obtain, by hook or by crook, an exorbitant return is the cause of dire financial disorder. As usual in our review of the year, we shall in the first place consider:—

SUBMARINE TELEGRAPHY.—It may be interesting not only to indicate the work of the past year, but also to give a brief account of the present position of the principal companies. The figures given are not guaranteed as absolutely accurate, because the changes are continuous, but so far as we have been able to make them they are correct to date. Commencing with the Atlantic Companies, we have the *Anglo-American*, with a capital of seven millions, consisting of £2,669,380 ordinary, £2,165,310 deferred, and £2,165,310 preferred stock. The Company had at the commencement of 1880 about 8,525 miles of cable, which had been laid since the year 1856. During the year just past *The Telegraph Construction and Maintenance Company* manufactured 1,618 miles of new deep sea cable for the Anglo Company, which cable was connected to the 264 miles of shore ends of the 1866 cable, thus giving the Company another line of communication across the Atlantic. Besides this 1,618 miles, the same manufacturers made a three-wire cable of 110 miles, and laid it from Placentia to St. Pierre; also 180 miles of similar three-wire cable, which was laid between St. Pierre and Sydney. These two last cables, it will be seen, are equivalent to 885 miles of single wire-cable.

The financial results of the year are not known at the time of writing, and the report for the past half year will not, in the usual course of affairs, be issued till the end of this month or the beginning of February. However, under the able management of Mr. Weaver and his colleagues we have no doubt the shareholders will be satisfied that all will be done that can be done to command success. Last year the dividends paid were 5 per cent. on the consolidated stock, 6 per cent. on the preferred, and 4 per cent. on the deferred stock.

The Direct United States Cable Company has a capital of £1,300,000, the whole of which has not been issued; but there has been an issue of 1,000 debentures at £100, a fourth only of which has been called up. The Company owns 2,983 miles of cable, laid in 1874-5. The dividends under its present management seem to be an uniform 5 per cent.

The Brazilian Submarine Company, with cables from Lisbon *viâ* Madeira and St. Vincent to Pernambuco, has a capital of £1,300,000. The length of cable is 3,667 miles, laid in 1873-1874.

Besides the foregoing there is the new French Company, having a cable across the Atlantic, and one from Brest to Porthcurnow, so that altogether the Atlantic Cable companies, with a capital of about eleven millions, have nearly 20,000 miles of cable, and yet more competition is threatened. The mover in the new scheme is said to be Jay Gould. We have more than once given our opinion as to the value of new investments in Atlantic cables, but it will do no harm to state them again. The existing cables are adequate to carry all the business likely to come for very many years, and money invested in new Atlantic cables is absolutely thrown away. The promoters of such schemes are past hope; their only residence should be of a circumscribed area. If speculators in America persist in the attempt to carry out such a foolish scheme as the manufacture of two new cables, we trust not a single penny of English money will find its way into the capital of the Company.

Turning from the West to the East, we must consider the *Eastern Telegraph Company*, with a capital of nearly four and a-half millions, and a debenture issue of £882,000, owning over 16,000 miles of cable besides land lines, laid since 1868. The policy of Sir James Anderson, the managing director, Mr. Pender, M.P., the chairman, and their colleagues, seems to be at once definite and simple. It may be thus stated, "to make failure almost impossible." Most of the important lines are duplicated, some triplicated as well as duplexed, and a reserve fund is insisted upon as a remedy against any sudden demand through accidental breakage or lapse of life in the cable system. Whilst the future interests of the shareholders are thus considered, a steady 5 per cent. has been paid. The confidence in the policy of the directors will be seen from the price of the shares, which has for some time been close upon or touching par.

A similar feature is to be observed with regard to the shares of the *Eastern Extension*, which are quoted just above par. The latter Company has a capital of three millions, of which over one million is unissued; but the paid-up capital together with debentures, is close upon £2,900,000. The number of miles of this Company's cable was, at the end of 1879, about 8,723, but large additions have since then been made. The duplication of the Australian line has been com-

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pleted. *The Telegraph Construction and Maintenance Company* manufactured the cables, and laid them as follows :—

Penang to Malacca	275	miles	laid in	1879
Malacca to Singapore	116	„	„	„
Singapore to Banjoewangie.....	919	„	„	„
Banjoewangie to Port Darwin..	1,132	„	„	1880

or a total of 2,442 miles. Part of this work was completed in 1879, and was noticed in our summary that year. The ss. "Edinburgh," "Scotia," and "Seine," belonging to the Telegraph Construction and Maintenance Company, were employed in this work, the "Edinburgh" making two voyages. In addition to the above, the Company has had constructed and laid by the Telegraph Construction and Maintenance Company the Hong-Kong-Manilla Cable, 529 miles in length, upon which work the ss. "Calabria" was employed, thus bringing the grand total to nearly 10,400 miles of cable.

Connected with the Eastern Telegraph Company, and under almost similar management, is the *Eastern and South African Telegraph Company*, owning some 3,855 miles of cable. This line has been completed just over twelve months, and the directors' report on the year's work will be looked for with some interest.

The Great Northern Company of Copenhagen has a capital of one-and-a-half millions, and pays from 6 to 7 per cent. During the past year the Telegraph Construction and Maintenance Company has manufactured and laid a new cable from Newbigging to Arendal and Marstrand, 518 miles in length, employing the ss. "Edinburgh" on this work. The Company has 4,850 miles of cable.

It is not generally supposed that the Government has many cables, but in shorter or longer lengths they have some thousand miles in the United Kingdom, to which may be added the 1,700 miles belonging to the Indo-European system. The *Direct Spanish Company* has nearly 800 miles of cable, the *German Union* 330 miles, the *Submarine Telegraph Company* 600 miles, the *West Coast of America* nearly 1,700 miles, while the *West India and Panama* and the *Western and Brazilian* companies have respectively about 4,100 and 2,500 miles of cable. The capital of the two last companies is respectively £1,275,530, with £14,200 of debentures, and £1,398,200, with debentures amounting to £302,990.

The foregoing is a very brief abstract of the position of the cable companies. Besides the additions already mentioned as having been made during the year, the *Telegraph Construction and Maintenance Company* has manufactured and laid a short cable of 109 miles for the New Zealand Government, to connect North and Middle islands, employing for the work the ss. "Kangaroo." We may put on record a rather interesting fact in relation to the return of the "Kangaroo," as, to the best of our knowledge, no similar performance has been published. The vessel steamed from Wellington to St. Vincent, a distance of some 9,500 miles, without once stopping her engines. We have noticed the policy of the largest companies in duplicating their systems, and duplexing their cables. The system of duplexing adopted in all cases with, we believe, only one exception, is that of Dr. Muirhead, under whose supervision most of this work has been done. After duplexing the "Direct" Cable, it was found that the thick fogs of the North Atlantic, penetrating into the nooks and crannies of the offices at Torbay and Nova Scotia, played havoc with the insulation of the ebonite. To obviate this defect, Dr. Muirhead has enclosed the artificial cable in air-tight cases, kept dry by the use of chloride of calcium. Another improvement in duplex working effected at Penang and Madras is to introduce a specially-designed small Thomson recorder with permanent magets into the circuit between the signalling battery and the differential apparatus, so as to record the outgoing currents, an improvement which gives an effective check on the "sender." It may be mentioned here that Dr. Muirhead and Mr. Frederick Field, F.R.S., have been for a long time experimenting on a new insulating material called NEGRITE, which is the invention of Messrs. Field and Talling.

The India Rubber, Gutta Percha, and Telegraph Works Company at Silvertown have manufactured a fair quantity of cable during the year. On July 7, the manufacture of some 575 miles of cable for the French Government was commenced, and the work completed on September 8. The shipping of the cable on board the "Dacia" commenced on August 18, and ended on September 9. This cable was laid from Algiers to Marseilles. The same Company has manufactured about 1,000 miles of cable for the Canadian Government and for the Mexican Telegraph Company. The portion for the latter is now about to be laid. About 100 miles of short lengths of torpedo cable has been made for the Chinese and Japanese Governments. We believe that the Silvertown Company supplies the remaining portion of the torpedo apparatus as well as the cable. The Company has also made short lengths of torpedo cable for the British Government.

We have not heard that Messrs. Siemens have manufactured any cables during the year; but it is stated that if the American speculators arrange matters, this firm will be employed to construct and lay the new cables.

INLAND TELEGRAPHS.—During the past year some portion of the projected extensions have been advanced or completed, notably the trunk line from London to Glasgow. 325 miles of new line have been covered, and additional wires measuring 5,020 miles erected. Much attention has been devoted to the improvement of apparatus, a great part of which has been remodelled and adapted to meet the continual growth of traffic. This is especially the case with automatic appliances which, with the aid of fast speed relays, now admit of the extreme speed of the sending instrument being realised at far greater distances than heretofore. We may mention for example that a single circuit 650 miles long, going from London to Aberdeen, and embracing Leeds, Newcastle, Edinburgh, Glasgow, and Dundee on its way, is worked night and day at a rate of 200 words per minute—all the places reading simultaneously. Two relays, or fast speed repeaters, which serve in this instance, are fixed at Leeds and Edinburgh. For direct automatic working the speed generally, we are gratified to learn, has been raised from 130 words per minute, which was the average for last year, to one which now scarcely falls short of 250 words per minute. On the hand-worked circuits the "sounder" instrument is being rapidly introduced, and greatly conduces to speed of manipulation. These improvements have not more than kept pace with the growth of traffic, which in the year just ended has amounted to 29,571,005 messages, as against 25,375,524 in 1879, showing that messages despatched throughout the United Kingdom have, compared with the preceding year, increased by 4,195,481. The following table shows the number transmitted in the corresponding quarterly periods :—

QUARTERS ENDED	1879.		1880.
March	5,528,143	.....	6,699,756
June	6,261,801	.....	7,572,337
September	6,786,166	.....	7,889,162
December	6,799,414	.....	7,409,750
	25,375,524		29,571,005

We find that our review of Electric Light Operations and other matters must be left over till next week.

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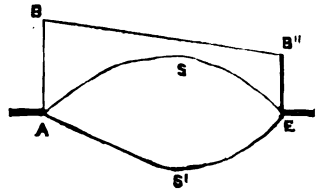
LESSONS FOR LEARNERS.

(CONTINUED FROM PAGE 69.)

A modification of the apparatus just described gives us one of the most useful instruments in telegraphy. Just as the civil engineer requires his rule, his tape, and his chain for measuring lengths, so the telegraph engineer requires his instruments for measuring resistance. The engineer, however, cannot always measure directly. He may want to know the breadth of an arm of the sea or the height of a mountain, places where his two-foot rule or his chain of a hundred links would be useless if he attempted to measure with them in a direct manner; therefore, he sets about such work in another way, measuring exactly a base line, and then observing certain angles, and calling to his aid a branch of elementary mathematics termed trigonometry, he gets the required result. We shall not need the aid of trigonometry; an elementary knowledge of algebra will suffice to enable us to understand the theory of the instrument to which I have alluded.

It is an almost universal law that nature's forces act in the most economical manner; and who is bold enough to say the law does not hold good with man and beast? You see the horse zig-zagging up the hill with his load, and a well-known Professor, if I mistake not, cited the Dublin fishwomen as unconsciously following the same law. At any rate, we shall find that electricity never takes a difficult path when an easy one is open to it. Look at this figure again, and I will explain what I mean. Suppose

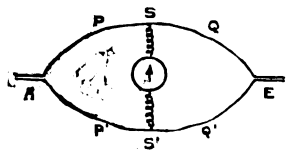


the arms S and S′ not to be similar, but that S′ is the larger wire (both being of the same material), then we shall find of the current at A a greater quantity going through S′ than S. The law which I must ask you to take for granted at present is that the current divides itself inversely as the resistances; so that if the resistance of S is double that of S′, calling these resistances 2 and 1 respectively, the current at A may be looked upon as divided into three parts, two of which go through S′, and the remaining part through S. Putting this down in the shape of a table, you will see better what "inversely" means:—

Wire.	Resistance.	Current passing through.
S	2	1
S′	1	2

In other words, the wire of *greatest* resistance has the *least* current, while the wire of *least* resistance has the greatest current.

In the next figure we have seen that the current goes from

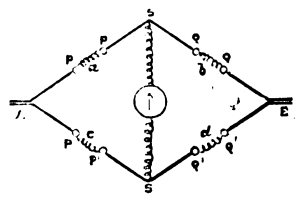


A to E because E is at a lower potential than A. The current has a choice of paths:—

Part may go along	A P S Q E
,, ,, ,,	A P S′ Q′ E
,, ,, ,,	A P′ S′ Q′ E
,, ,, ,,	A P′ S Q E

and it depends upon the resistances of the four branches—A P S, A P′ S′, S Q E, S′ Q′ E—as to the path through which the greatest portion of the current flows.

Mr. Christie, a Fellow of the Royal Society, was the first to devise an instrument with four branches of this kind, but owing to the instrument having been prominently brought before the public by the late Prof. Wheatstone, it is called "Wheatstone's Bridge." The form illustrated below is seldom used, but I can



describe it more easily with such a form. P P, Q Q, P′ P′, Q′ Q′ are binding screws, to which wires of the same or different resistances can be connected. The galvanometer is placed between S and S′.

The aim generally when the bridge is used is to so arrange the various resistances that the *potentials* at S and S′ shall be equal, and *no current passing through the galvanometer the needle remains at rest.*

The law to be followed in the arrangement we must now find.

Let x be the potential at A
x' ,, ,, E
y ,, ,, S
y' ,, ,, S′

When no current passes from S to S′ or from S′ to S the potentials at these points are equal and

$$y' = y.$$

Under this condition whatever current passes from A to S will pass from S to E, that is the current is uniform along A P S Q E.

What determines the current from A to E? The difference of potentials, or $x - x'$, in Ohm's law is denominated E. You recollect our discussion of the formula $C = \frac{E}{R}$.

In the case before us, then, putting $x - x'$ instead of E, we have $C = \frac{x - x'}{R}$.

What is R?

It is the resistance of the arms, A S and S E.

Call these a and b respectively, and instead of R put its equivalent $a + b$.

We get $$C = \frac{x - x'}{a + b}.$$

Treating the arm A S in the same way, the difference of potentials is $x - y$; the resistance is a.

Thus we get $$C = \frac{x - y}{a}.$$

Taking the arm S E, we get

$$C = \frac{y - x'}{b}.$$

Similarly, we might consider A P′ S′ Q′ E,

getting $$C = \frac{x - x'}{c + d}.$$

And in the case of the arm S′ E,

$$C = \frac{y' - x'}{d}.$$

If the potentials at S and S′ are equal, then $y' = y$, and the last equation, may be written

$$C = \frac{y - x'}{d}.$$

Taking the potentials at S and S′ as equal, then the current in A P S Q E being uniform,

$$\frac{x - x'}{a + b} = \frac{y - x'}{b},$$

whence $$\frac{x - x'}{y - x'} = \frac{a + b}{b} \quad \ldots\ldots\ldots \quad (1)$$

Similarly, $$\frac{x - x'}{c + d} = \frac{y - x'}{d},$$

whence $$\frac{x - x'}{y - x'} = \frac{c + d}{d} \quad \ldots\ldots\ldots \quad (2)$$

But a well-known axiom says that things which are equal to the same thing are equal to one another; and in (1) and (2) we see $\frac{a + b}{b}$ and $\frac{c + d}{d}$ are each equal to $\frac{x - x'}{y - x'}$; that is

$$\frac{a + b}{b} = \frac{c + d}{d}.$$

Whence $$a\,d + b\,d = c\,b + b\,d.$$

$$\therefore a\,d = c\,b.$$

This is the well-known rule of proportion, in which three quantities are given to find a fourth. Suppose d to be the unknown quantity, then $d = \frac{c\,b}{a}$.

It is easily seen that when the resistances a and c are equal the resistances b and d must also be equal, and again the ratio that exists between the resistances a and c must also hold between the resistances b and d. A numerical example or two may, per-

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haps, help to make this clear. If the resistances at a, c, and b are 10, 10, and 100 respectively when S and S′ are at equal potentials, then d will equal 100, for

$$d = \frac{c\,b}{a} = \frac{10 \times 100}{10} = 100.$$

If a, c, and b are respectively 10, 100, and 264,

$$d = \frac{c\,b}{a} = \frac{100 \times 264}{10} = 2640.$$

If a, c, and b are $\frac{1}{10}$, 100, and 264 respectively,

$$d = \frac{100 \times 264}{\frac{1}{10}} = 264{,}000.$$

(TO BE CONTINUED.)

CORRESPONDENCE.

ELECTRIC LIGHTING.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Mr. Charles Lever, of Bowdon (Cheshire), favours us in a late issue with some remarks relative to the electric light at St. Enoch's Station. Perhaps you will permit me, as Mr. Crompton's manager in Glasgow, to say a few words on the same subject.

It is true that the lamps were supplied by Mr. Crompton, but they are some of the earliest made, and further than that he has had no connection with the management of the light there. In spite of the unpleasant flickering alleged by Mr. Charles Lever, the railway company apparently possess some little confidence in this system of lighting, for I may mention some time ago. on the occurrence of a fog, an attempt was made to light the gas in the daytime, but this could not be accomplished, owing to the pipes having been so long disused. At Liverpool-street Station (G.E.R.)—the only station lit by the Brush system—the gas lamps, if not actually lighted, are maintained ready for immediate use. This hardly seems to concur with his dictum "that the Brush light is the most practicable of the two."

Perhaps Mr. Charles Lever might allow me to suggest that his regret, that the whole of the City lighting was not confided to the Anglo-American Company may be slightly misplaced, and that the object of the commissioners was to give the various systems an exhaustive trial, and ascertain which of them best fulfilled their requirements, which would hardly have been done had the contracts been disposed of in the manner he lays down.

Feeling that, as the representative of an English manufacturer, it would be mere presumption on my part to say more in the face of Mr. Paget Higgs's "judicious" remarks, I remain, yours, &c., T.

Glasgow, December 15th.

TELEPHONIC.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Can any of your readers tell me where I can get a good work on the "Telephone," and price?—Yours, &c.,

Dec. 29, 1880. A. V. KINSEY.

UNIVERSAL EXHIBITION OF ELECTRICITY.

The following is extracted from a document sent to us headed "Ministry of Posts and Telegraphs":—

GENERAL RULES.

General Arrangements.—The Exhibition to be open from August 1, 1881, in the Palais of the Champs-Elysées, till November 15, 1881.

A Commission under the presidency of the Minister of Posts and Telegraphs shall be consulted on the general measures to be adopted.

The necessary funds are arranged for by Government and guarantee subscriptions. A Technical and Financial Committee shall be constituted. The Technical Committee shall be composed of members of the Organisation Committee, to which a ministerial decree can add strangers.

The foreign countries which have adhered to the Exhibition will be invited to appoint special commissioners.

Admission and Classification.—Requests for space must be made by March 31, 1881. Answers on the subject of space granted, &c., will be made May 15.

The Foreign Commissioners will have the power of receiving in one block the space necessary for their respective nations. The cumulative demands of the Foreign Commissioners must be received by the Commissioner-General by March 31.

Foreign exhibitors belonging to countries which have not appointed special commissioners may correspond direct with the French Commissioner-General. Printed forms can be obtained at the office of Posts and Telegraphs, Rue de Grenelle-Saint-Germain, 101, Paris. The principal classifications are as follows:—Apparatus for producing or transmitting electricity, magnets artificial and natural, compasses, apparatus for the study of electricity, application of electricity to telegraphy in transmission of sound, production of heat, production of light, lighthouses and signals, advertising, mines, railways and navigation, military work, fine arts, electroplating and electro-chemistry, transmission of power, clockwork, medical purposes, astronomy, agriculture, domestic use, &c.; lightning protectors and rods, collections of apparatus of historical interest, collections of books on the subject.

Apparatus will be received in the Palais of the Champs-Elysées, from July 1, 1881.

The cases must carry addresses and special tickets furnished by the Commissioner-General.

Installation.—Exhibitors will have no rent to pay.

The Administration takes in hand the general decoration, &c., but exhibitors must at their own expense erect and decorate their own exhibits. The plan of these must be submitted to the Commissioner-General.

Motive power will be found at cost price to exhibitors requiring it.

Motive power will be found free during the experiments required for the work of the International Congress of Electricians organised by the State during the Exhibition.

Entrance.—The Exhibition will be open from 8:30 a.m. to 6 p.m., and from 8 p.m. to 11 p.m. Officials and exhibitors will have passes.

The entrance fee to be:

	fr.	c.
Morning, from 8:30 to 11	1	50
11 a.m. to 6 p.m.	1	0
8 p.m. to 11 p.m.	1	50
Sundays:		
8 a.m. to 6 p.m.	0	50
8 p.m. to 11 p.m.	1	0

Police and Superintendence.—Rigorous watch will be kept on all goods, but the Administration will not be responsible for losses.

No exhibit may be taken away before the close of the Exhibition.

No photographs or drawings may be taken of exhibits without authority of the exhibitors, countersigned by the Commissioner-General.

Exhibitors must maintain and clean their places of exhibit.

A place for empty cases will be arranged, for which a charge of 6fr. per cubic metre will be made.

A catalogue will be arranged by the Commissioner-General. The contractor for the catalogue can arrange with exhibitors for the insertion of notes, cuts, &c.

Diplomas of merit and medals will be accorded by a jury.

All communications relative to the Exhibition must be sent, post paid, to "Le Commissaire général de l'Exposition internationale d'électricité, Palais des Champs-Elysées, porte no. IV., à Paris."

CABLE-LAYING IN GUIANA.

BY J. MUNRO, C.E.

(CONTINUED FROM PAGE 57.)

A fire is made with the nuts of the Urucury palm, and a calabash with a hole in its bottom is inverted over it. Through this primitive chimney the thick, white smoke of the burning nuts rises into the air. A wooden mould, shaped like a spade, is dipped into the rubber juice, and then held in the smoke until the film of caoutchouc has dried upon it. It is dipped again into the juice, and again held in the smoke; and so the process goes on, each time a new layer of cured caoutchouc being added. When the skin, or plancha, is considered thick enough it is slit with a knife and taken off the mould. The caoutchouc is then ready for export to America and Europe. A Tapuya will collect on an average 8lbs per day, and for this he receives at the rate of 1s. 8d. per lb. In 1869, over £800,000 worth of rubber was exported from Pará. Besides the great variety of domestic uses it is applied to, Para rubber is now employed as an insulator for submarine cables, and the cable we were about to lay from Para to Cayenne was insulated with rubber which had once grown in these forests.

A favourite resort of ours was the "high woods" behind the city. A tramway car takes us out of the town, past the little suburb of Nazaré, with its pretty tinted rosinhas or villas of the Para merchants, set in trim

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gardens, decorated with delf ornaments and splendid tropical plants, to a saw mill right in the heart of the primæval forest. The tramway track exposes the heart of the primæval jungle, as a railway cutting exposes the strata of the earth. It is impossible not to be overcome with silent astonishment and awe at the extraordinary profusion of vegetable life, which on either side towers a hundred and fifty feet above us. The soil, formed of the decay of root, branch, and leaf for centuries, is a very hot bed—the warm humid atmosphere is that of a forcing house. Giant ceiba trees, the Titans of the forest, uprear their great trunks, crowded with wild pines, which perch upon their branches, and hung with parasites which deck them with flowers and drape them with verdure. Immense lianes bind all the trees together, sometimes swinging from one to another in graceful festoons, sometimes coiling round each other like enormous boas, and sometimes dropping sheer to earth like a pendulum from some lofty bough. Striking contrasts are everywhere paramount. A lusty lily orchid with broad green leaves, and a great creamy spathe ready to burst springs from the rotten wood of a mossy stump. A wild pine with a rich truss of orange flowers is perched upon the loop of a bare liane; a crimson passion flower dangles out of the leathery foliage of a wild fig. Some of the orchids are like a tress of young grass flung up into the trees. A gold-green lizard is basking in the dry sand of the track. A dazzling blue morpho butterfly, like a sheet of azure tinsel, flaps past us in the sunlight; a brilliant bird or beetle darts through among the branches; a scarlet dragon-fly hovers an instant in mid-air on gauzy wings, then vanishes as suddenly as it appeared. One sees that the earth is teeming with life, yet there is a noonday hush, an awful silence over everything; the air is absolutely still, and almost stifling. The rule of life here is ruthless prey; the law of nature is a pitiless survival of the fittest; decay only serves to fatten life, and loathsomeness affords a foothold for beauty. An Indian squatter's hut nestling at the bottom of this sea of foliage and vegetable life seems to point out the insignificance of man in relation to the overwhelming life of the tropics. The squatter is enjoying his siesta in a hammock under his palm-leaf roof, while his little daughter, a pretty brown thing with large black eyes, and long glossy hair, plays with a tame toucan on the earthen floor. There is no place for poetry and romance here, where there is no arcadian turf to lie upon, and the ants or other insect pests swarm over every foot of the ground. The poetry of tropical forests is all in contemplation.

Some of the houses of the wealthy riverside planters in the neighbourhood of Para are quite manorial in their character. One day, shortly before leaving, a party of us were invited to bathe in the river, and lunch at the house of Senhor Danin, a large proprietor and owner of a tile works, situated on the shore of the river a few miles east of Para. Senhor Danin belongs to the patrician school of planters, and maintains the traditionary Portuguese hospitality. Sometimes he will entertain, on the anniversary of his patron saint, a score or two of guests for a week or more, with tables groaning under fruit and wines all day, and music and dancing half the night. He owns over fifty slaves, and every year they are allowed their saturnalia.

The house is a large whitewashed brick building, with red-tiled roof, surrounded by grassy lawns, flower gardens, and fruit trees. A covered balcony extends along the front, and a green wooden verandah runs round the sides of the courtyard. The senhor, a stately old gentlemen, dressed in white linen, with diamond rings on his finger, welcomed us with easy courtesy, and led us to the family bathing place. Every mansion here has its bathing place and its chapel.

After bathing—and bathing in the Amazon is delightful—we lunched on the balcony off sweet limes and oranges, biscuits and guava jelly. From here the view across the wide brown river, glittering in the vertical beams of the sun, with the sombre green islands looking treacherously beautiful under the thunderous sky, was very grand. Behind us we could see into the open courtyard, where the ranges of green verandah were slung with hammocks, from which the ladies of the house occasionally stole a glance at the interesting foreigners.

On the east extended a grassy lawn, very green and fresh, and dotted with trees like an English park. Three fine old breadfruit trees stood close to the house, their limbs bearded with mosses and lichens and luxuriant with magnificent bunches of the dark green acanthus-like leaves and spiky fruit. The sward sloped to the river side, where cocoa palms grew out of the sand, and a single rose-coloured ibis was feeding like a hen. To complete the picture, two half-naked negroes in a dug-out canoe could be seen paddling round a point of the shore.

On leaving we passed under a shady iron trellis archway, overgrown with a passion flower, whose ripe fruit hung like melons overhead, and then went through the garden, a place full of sudden antithesis. Gaudy-leaved plants sprung from the old wall; a creeper, more flower than leaf, clung to a withered pole. From a broken vase, half buried in the sun-baked earth, a gold-green lizard crept forth. Out of the dry sand grew scanty bushes, sprinkled with deep-hued flowers—flowers of scarlet, pink, and carmine, and the naked-limbed frangipanni dropped its heavy-scented blossoms on the earth. Bowers of honeysuckle and jassamine, and even of stunted roses, created shady retreats. It was evidently an ancient place, for lichens grew over its dial stone and monumental vases. Humming birds—or "kiss flowers," as the Portuguese call them—quivered over the inga blossoms, and larger birds of dazzling plumage flew from grove to grove, or hopped about on the chequered pathways. There was no cool grass to lie upon, no sparkling fountains, but the air was heavy with perfume, and the broad, fierce sunshine that burned over everything made the shade of the garden cool and inviting.

But we have lingered, perhaps, too long over these scenes at Para. The "Hooper" certainly lingered there too long for the profit of the enterprise. But this was due to some faults which developed themselves in a portion of the cable, apparently because of the heat of the tropics, and notwithstanding the well-known fact that india rubber cables endure heat much better than gutta percha ones. At length, however, the gang of slaves who had been hired to assist in turning over the cable in order to extract the faults, were dismissed with a noggin of grog apiece, the shore end cable to connect the ship to Para was coiled into a barge ready to be laid on the morrow, and the trench from the river side to the telegraph office in the city, to receive the cable, had been dug. Monkeys, racoons, and green parrots were to be seen in great variety round Jack's quarters in the forecastle, and some of the latter were already practising a few choice specimens of the English tongue. Even the saloon was gay with trophies from the Amazon, and one young electrician of our party, with a keen English instinct for sport, had filled his berth with specimens of all kinds. A spotted tiger's skin sprawled over one wall, and myriads of beetles, butterflies, grasshoppers, and spiders were pinned to the other, while the odour of camphor and other preservatives was well nigh stifling. It was a small berth, and he shared it with a gigantic Aberdonian, who by no means relished his new company, especially the insect portion of it, and declared most emphatically that C—— had turned the berth "just into a menagerie." One day C—— brought in a great prize, in the shape of a lively young tarantula, which he stowed away in a cigar box in a drawer just under the two beds—first killing it, however—unknown to K——. That night C—— was awakened by hearing a loud slap in K——'s bed, followed by a hasty jump and a muttered execration. He looked out, and saw K—— towering in his pyjamahs, with a horrified look upon his face. "That beast of yours has broken loose," cried the Scotchman. "Not at all, I assure you," said C——, "it's only fancy." "Fancy," said K——; "Hoot, mon, I heard it bummin."

One day before leaving we entertained the President of Para and a distinguished company of the citizens on board the "Hooper" to lunch. The President, an intellectual looking young man, made a sonorous speech in Portuguese, which none of us could understand, but which, we were assured, extolled the triumphs of English engineering genius over every other, and placed our humble selves in the front rank of telegraphic worthies. A liberal amount of champagne was drunk, and even Portuguese formality thawed under its genial influence. The President evidently preserved his gravity with great difficulty. Captain Talisman, a Brazilian who had ascended the Amazon with Agassiz, and our chief engineer fell upon each others necks and called each other "old dog" with every token of affection. Sober Naussmann, a German electrician, declared that the German Emperor was a hard-hearted tyrant, and Bismarck little better than Mephistopheles. G——, a ne'er-do-well operator, once destined for the Church, but whose evil fortune had landed him on a telegraph ship, stal ked about with his hat crushed over his brows, and recited fragments from the tragedies of Sophocles, until the American consul threatened to have him shot if he didn't stop his "darned orating."

In short, we all fraternised in the friendliest manner, and "Auld lang syne" was sung, when, with many adieux and much waving of handkerchiefs, the party left the ship.

On June the 15th the shore end was landed in the morning; about midday the huge anchor was drawn up out of the soft Amazon mud to the tune of "Up she rises," sung by the men at the capstan, the engine throbbed, the screw revolved, the cable ran out over the stern sheave, and without more ado the "Hooper" slipped away down the river, paying out cable as she went.

During the laying a submarine cable runs, or rather is pulled out of the ship by the weight of the portion hanging between the ship's stern and the sea bottom. The engineering operations consist in guiding and controlling the running out. For this purpose an iron crate or crinoline is placed over the cable in the open tank to prevent it from lashing about as it runs out while the ship is rolling, and pulleys are set to guide its course to the stern sheave where it leaves the ship. To control the rate of running out and keep it a little over the speed of the ship, so as to allow for the cable being laid sufficiently slack along the bottom to admit of its being grapnelled and hauled up to the surface again for repair in future if necessary, the cable is passed two or three times round a large friction drum, whereby its velocity of egress is regulated by that of the drum. A dynamometer placed near the drum measures the strain on the cable, and enables the engineers to see that it is not in excess. Since the velocity with which the cable runs out depends on the weight of cable hanging from the ship, and since this changes with the depth of water over which the ship passes, it becomes necessary to apply friction to the drum to restrain the cable, and also to alter the speed of the ship in order to prevent an undue amount of slack or tightness in the cable when laid.

(TO BE CONTINUED.)

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Direct United States	10⅞,	11	.....	11¼	.....	10⅞
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Do. Five per Ct. do. 1899	102,	106	.....	—	.....	—
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Do. Six per Ct. Deb	109,	112	.....	—	.....	—
German Union	10⅛,	¾	.....	10⅛	.....	10⅛
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Do. Six per Cent. 1st Preference	6⅞	7⅛	.....	7 3-16	.....	7
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Do. Six per Ct. Sterg.	104,	107	.....	—	.....	—

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ABSTRACTS OF SPECIFICATIONS.

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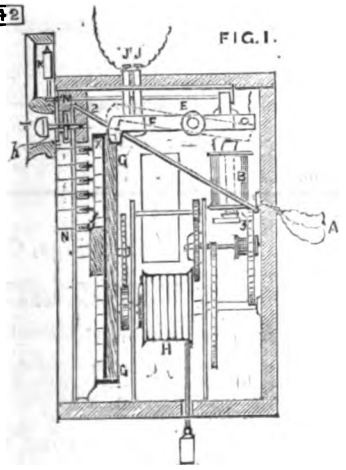
We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts—ED. *E.*]

1942. IMPROVEMENTS IN AND RELATING TO APPARATUS FOR TRANSMITTING FIRE ALARM AND OTHER SIGNALS.—*By William Phillips Thompson.—(A Communication from Abroad, by Monsieur Jaques Victor Michel Bartelous, of Bruxelles, in the Kingdom of Belgium.)*

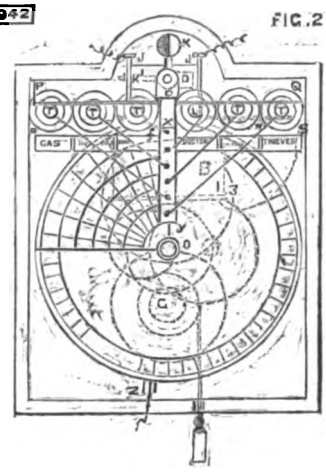
"The automatic system which I have invented," says M. Bartelous, "works by electricity, and enables one to place upon a single wire an indeterminate number of instruments, each possessing a particular signal which makes known to a receiving office which apparatus has been at work." This apparatus can render in particular the following services:—First, it establishes an automatic communication between the notifiers of conflagrations (hereafter called the alarm givers) and an office, whether of police or otherwise; second, it puts into the hands of certain persons a means of prompt communication, enabling them to call in medical or police

1942 FIG. 1.



assistance, or any other aid it may be considered useful to organise, independently of any other applications that the same system may receive. The alarm-givers, whatever be their system, are in electrical communnication on the one hand with the ground, and on the other with a terminal, whence the current passes to an electro-magnet. During the passage of the current in the magnet its soft iron cores attract a soft iron armature which terminates transversely a lever. This latter being made of conducting material with the exception of its axis, which insulates it, establishes when in repose electrical communication with the central battery by a movable piece fixed on a shaft. When the lever turns on its axis and takes the new position, this movable piece, which was supported on the lever, is released and takes a new position, the axis turns round a quarter of a circle, and with it the indicator needle K, terminated by a heavy disc which turns and takes the position K^1. This needle moves in a glass case, and according to its horizontal or vertical position one is enabled to see whether the apparatus has been at work or not. The rocking movement of the lever breaks communication with the movable piece, and causes the suppression of the alarm-givers. At the same time the clutch by which the lever is terminated at its other extremity rises and produces the liberation of a wheel, G, which turns round by means of clockwork. On the fore part of the lever F there is a block which, when in repose, rests upon two pieces, themselves supported by rods J, J^1. The right one J^1 establishes communication with the receiving office, the battery, and the earth, the left, J, with the remainder of the system (or line

1942 FIG. 2



wire). The movement of the armature raising the block cuts off all communication with the line wire and receiving office. The interruption of the current from the line wire whilst the apparatus is in action, and its restoration thereto after the revolution of the dics, may be produced by a supplementary mechanism replacing the action of the rods. The first rod is entirely suppressed and replaced by a flexible conducting wire, which connects the terminal J to the cross-piece carried by the lever. The second rod is shortened, and instead of descending to the cross-piece it is terminated at K by a hook at right angles. A metallic piece in the form of a V, and movable round the axis H, replaces the original arrangement. The lower branch of this piece is terminated by a heavy weight, G, which rests upon one of the extremities of the cross-piece I: the other branch ends in a thin blade, and rests when the apparatus is in repose upon the projection K at the end of rod J^1. When in this position the current, therefore, passes from the terminal J^1 through K, G^1, H, G, across the pieces I I, along the flexible wire *f f*, and joins the terminal J, where ends the line wire of the rest of the system. If, on the contrary, the apparatus is at work the lever F, and consequently the cross-piece I I, are raised; the piece G, H, G^1, partakes of this movement, oscillating around the axis H, and the current no longer gets beyond J^1, since the contact is broken between G^1 and K. The wheel G is the medium for giving the signals. It is divided on its first quadrant into six or more concentric bands, each of which is put into communication (by a small wheel rolling upon it as it rotates) with a similar number of contact makers, T, above each of which is inscribed the destination or duty assigned to it. When the apparatus is in repose these little wheels rest upon an insulating band, X Y. In the three other quadrants the wheel does not carry any signals except upon the outside circle, and the signals there inscribed signify, according to their number as to series and order, the house which is setting the apparatus in action. The five concentric bands around the centre carry special arrangements corresponding to the services asked for, and these signals are transmitted by pressing down one of the five buttons T. As to the sixth band it can, by means of a button, L, be put into communication with the office for a voluntary signal of conflagration. It is divided on its circumference into four sections; the first is made of conducting material, divided into a small number of divisions, and sets an alarum in motion; the second, which takes up the rest of the first quadrant, is an insulator; the two last carry signals which indicate the series and number of the house. Whilst the outside circle carries an insulating band, the wheel uses the space to produce special signals. Outside the concentric circles which have just been described there is round the whole circumference of the wheel a metallic band, upon which rests a spring which establishes a permanent communication with the earth. The apparatus is capable of producing two sorts of signals, one sort automatic, the other voluntary. In order the better to explain the working of the apparatus, the wheel is supposed to be divided into sixty divisions, although the system permits of as many divisons and as many contact makers for alarms as experience may show to be useful. As soon as the electric current is closed automatically by the agency of an alarm-giver, an alarm bell rings in the receiving office and gives notice of a conflagration, the armature of the transmitting apparatus turns on its axis, and the wheel G is set in motion. The ringing continues during the rotation of a portion of the wheel, this portion being a conductor, and of greater or less extent, over which I suppose the last concentric circle; during the rotation of the part, since this circle is an insulator, communication is interrupted, and the ringing ceases; but when the three other quadrants of the wheel are passing the successive openings and closings of the current produced by metallic pieces inserted into the mass of the wheel, the greater part of which is insulating, somewhat in the fashion of type in a composing stick, they transmit a series of signals, the particular combination of which indicates first of all the series and then the number in this series of the house whence was despatched the signal of distress.

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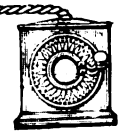

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South Africa—Telegraphic communication with the Transvaal is entirely interrupted.

Melbourne to London.—A telegram passes over 13,695 miles of wire between Melbourne and London.

Postal Telegraphs.—The Revenue returns for the past quarter show an increase of £195,000 on the item recorded as telegraph service.

South America.—Cable between Rio de Janeiro and Bahia is interrupted. Messages can, however, be forwarded over the Brazilian Government land lines.

The Post Office and Telephony.—We believe that the applications from the public for telephonic facilities under Government control are exceedingly numerous.

Personal.—Messrs. A. W. Foord, E. A. Kenyon, H. S. Olphert, and A. P. Hill have been appointed assistant superintendents in the Indian Telegraph Department.

The Society of Telegraph Engineers and Electricians.—The next meeting of this society takes place on the 26th inst., when the new President will deliver his address.

Electric Lighting.—The Commissioner of Public Works, New York City, has granted Mr. Edison a permit to introduce his system of electric lighting in the lower part of this city.

In Memorium.—A tablet has been erected in the Shooter's Hill Cemetery by the staff of the Eastern Extension Company, in the memory of H. T. Fisher, Esq., for some years the electrician of the Company.

New York.—Marvin Green, Tracy R. Edson, James H. Baker, T. A. Edison and others have filed articles of incorporation as the Electric Illuminating Company, of New York, with a capital of 1,000,000 dollars.

The Submarine Telegraph Company.—The new premises being now completed, this company is removing from Threadneedle-street to London-wall. The instrument room, however, will remain where it is for a week or two longer.

Royal Institution of Great Britain.—At the Friday evening meeting on January 21, Warren De La Rue, Esq., D.C.L., F.R.S., Sec. R.I., will lecture on "The Phenomena of the Electric Discharge with 14,400 chloride of silver cells."

Borneo.—In 1879 gutta percha and india rubber to the value of 27,720 dollars was exported from Brunei to Singapore, while Labuan and Sarawak exported to the value of 47,513 dollars and 361,794 dollars respectively. This total amounts to over £91,000.

Victoria.—The telegraphs are incorporated with the Post Office, the expenditure accounts are combined, but the revenue accounts are kept separate. In 1879 the revenue from electric telegraphs was £56,705, against £60,288 for 1878, or a decrease of £3,583.

The Word Rate.—We understand that the word rate between this country and the Continent has proved a great success. The expenses of management have of necessity been greatly increased; but this is fully compensated for already by the additional traffic.

The Transmission of Force.—*La Gaceta de la Industria*, a new publication from Barcelona, contains the first portion of a paper on the "Transmission of Force to a Distance by Means of Electricity," which discusses the work of Ayrton, Perry, Siemens, &c.

Reunion.—Progress is shown in the island, inasmuch as a railway is to be constructed, and the telegraph wire, which was hung up in coils on the branches of trees skirting the high road around the coast, is to be once more stretched out and follow the track of the railway.

The Cuba Submarine Company.—The s.s. "Hooper," belonging to Hooper's Telegraph Works Company, is about to take in 400 miles of cable with Hooper's coil, at the Company's Works, Millwall Docks, to be laid along the coast of Cuba, for the Cuba Submarine Telegraph Company.

Compagnie Francaise du Telegraphe de Paris a New York.—We are informed that owing to the appearance of a fault in this company's Brest St. Pierre cable, the nature of which has not yet been determined, it is considered advisable not to accept messages from the public for the present.

The Congress of Electricians.—Our attention has been called to Article I. of the Decree of October 23, which says the Congress will be opened under the presidency of the Minister of Posts and Telegraphs. It will thus be seen that the rumour as to the Prince of Wales being President is incorrect.

The Postmaster-General at Manchester.—According to the *Standard*, Mr. Fawcett was requested to meet a deputation of clerks in the Postal Telegraph Department on the subject of a change in the scale of payments; but he refused to meet them on the ground of pressure upon his time and other considerations.

Algeria.—A consular report just issued states that on August 25th, 1879, the rate of messages transmitted by cable from Algiers to Marseilles was reduced from 20c. to 10c., that immediately the number of messages doubled, and the receipts, in spite of the decrease of 50 per cent. in the rate, exceeded what they were before.

The Cuba Submarine Telegraph Company (Limited).—The number of messages passing over the lines of this Company during the month of December was 2,284, estimated to produce £2,300, against 2,637 messages, producing £3,317 in the corresponding month of last year. The traffic receipts for the month of October, estimated at £2,100, realised £2,102.

Prices.—The quoted prices of gutta percha are: Genuine, from 6d. to 3s. per lb.; for reboiled, from 2d. to 1s. The prices of india rubber quoted are, for Para fine, 2s. 11½d. to 3s. per lb.; Negrohead, 1s. 11d.; Central American, 1s. 6d. to 2s. 2½d.; Assam and Pegu, 9d. to 1s. 10d.; other East Indian, 1s. 1d. to 1s. 10d.; and Madagascar and Mozambique, 1s. 2d. to 2s.

America.—The electric system of illumination has been introduced into the Reading Iron Works with satisfactory results. There are thirty-two "double lamps," and it is estimated the cost to run these per night is 5 dollars, or a cost of about 1,500 dollars for 300 nights—a very great saving over gaslight, besides furnishing sufficient light for the men to work with the utmost satisfaction to themselves and their employers.

Map of Telegraphic Communications in Europe.—This excellent map has been designed from official documents by the International Bureau of Telegraphic Administration at Berne. The size of the map when mounted is about five feet

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by three feet, thus being on a large scale. The work has been well and carefully executed, and the maps should find a place upon the wall of every office in which telegraphy is an important item of business. The map is coloured.

Society of Arts.—Among the papers to be read during the remainder of the session we notice the following:—"Recent Advances in Electric Lighting," by W. H. Preece, Pres. Soc. Tel. Eng., on Feb. 23; "Flashing Signals for Lighthouses," by Sir W. Thomson, F.R.S., on March 2; "Deep Sea Investigation, and the Apparatus used in it," by J. G. Buchanan, F.R.S.E., on Feb. 24; "The Future Development of Electrical Appliances," by Prof. J. Perry, on March 24.

Messrs. Siemens.—The partnership heretofore subsisting between Ernst Werner Siemens, Charles William Siemens, and Carl Heinrich Siemens, under the firm of Siemens Brothers, of 12, Queen Anne's-gate, Westminster, telegraph engineers, electricians, and contractors, has been dissolved by mutual consent, and in future the business of the firm will be carried on by Siemens Brothers and Co. (Limited), which company will receive all moneys owing to the firm, and will discharge all liabilities thereof.—*Standard.*

College of Preceptors.—A few words concerning the examinations held by the College may not be amiss. We shall refer only to the paper on "Electricity and Magnetism," set by O. J. Lodge, D.Sc., the examiner. Is an examination paper of any real value which contains only four questions? As a rule a candidate passes if he obtains half marks. In this case if the value of each of the questions is the same, the answer to two questions means a certificate indicating knowledge in electricity and magnetism.

The Brush Light in America.—This electric light has just been introduced by the Boston and Albany Company, not only for lighting its large passenger station in Boston, but also its freight-house, engine-house and switching yard. Two electric lights suspended in the yard from high poles are found to greatly facilitate the night work of switch-tenders and train men. Six lights are used in the passenger station, and the whole number to be used about buildings and tracks is 32, supplied by two Brush machines.

Germany.—In the Post and Telegraph Department large sums have been spent since 1872, chiefly in telegraphs, under which head we should more particularly notice the laying of an underground cable from Berlin to the Rhenish Provinces and Alsace-Lorraine, and pneumatic tubes in Berlin. Under these heads we find an expenditure, in round numbers—4,000,000 marks in 1874, 7,500,000 in 1874, 11,000,000 in 1876, 14,000,000 in 1877,, 13,000,000 in 1878-79. The estimates for 1880-81 are moderate, the extraordinaries only 2,500,000.

The Gordon Lamp.—This lamp is, we understand, giving very satisfactory results. A light is obtained by it equal to about 40 candles from one coil of a new generator designed by Mr. Gordon. The machine now being experimented with has nearly 100 coils, and will maintain that number of lamps at an expenditure of two horse-power, exclusive of what is required for the exciter. The machine, which may be of any length, will carry twenty-four lamps per foot run of shaft; as many as 1,200 lamps could therefore be kept alight on a machine fifty feet long. Every lamp has its own circuit, and is absolutely independent of the rest. The patents will, we believe, be secured in a few days.

The Electric Light in Buchanan-street, Glasgow.—The first application in Glasgow of electricity to street lighting in a permanent form took place on the evening of January 3 at the new *Herald* buildings in Buchanan-street. The proprietors have also contracted with Messrs. Anderson and Munro, electric engineers, Glasgow, to light up the public offices and the composing rooms of the *Herald* and the *Evening Times* by electricity. The Gramme machines are those used, driven by an Otto gas engine, supplied by Messrs. P. Watt and Sons—gas thus curiously so far superseding itself. This gas engine also works the cyclic elevator in use during the day. The electric lamps are those invented by Mr. Brockie, formerly of Glasgow.

Italian Telegraph Statistics for the Year 1879.—The length of telegraphic lines in Italy increased from 24,830 to 25,533 kilometres, an augmentation of 503 kilometres. The length of wire increased from 82,676 to 84,101 kilometres, an increase of 1,426 kilometres. Eighty-six telegraph offices were opened to the public, 14 attached to railway companies. At the end of 1879 the telegraphic service was performed by 2,231 offices. The number of working apparatus increased by 105, the total being 2,407; 6,134,922 messages were sent, an increase of 464,079 over the preceding year; 4,933,001 private telegrams were forwarded in the country, and to foreign countries 818,021, the former showing an increase of 341,174, the latter 68,713. The revenue from all sources in 1879 amounted to 8,108,107 lire, the expenditure to 6,925,203 lire, leaving a net profit of 1,182,814 lire. The previous year showed a net profit of only 769,466 lire. The improvement was thus 413,348 lire.

Belgian Telegraph Service.—The length of the Belgian telegraphic lines in 1879 was 5.410 kils.; the length of the wires was 23,572 kils.; the batteries in use amounted to 1,219. This does not include 14 kils. of lines and 151 kils. of wires along waterways; nor 1,065 kils. of wires along 29 lines, set up at the cost of the concessionnaires and mostly used for private messages. On January 1, 1880, the telegraphic system of Belgium was composed of 24,788 kils. of wires. During 1879, 60 new telegraph offices were opened, bringing up the number to 708. Altogether, in 1879, from the three distinct sources of internal, international, and transit messages, there were derived 2,302,272fr. from 3,242,615 messages, against 2,179,713fr. from 2,960,746 messages in 1878. The cost of the service was 2,756,571fr., being some 421,566fr. in excess of the receipts. The cost of the first establishment of this telegraphic system was 4,022,080fr., equivalent to about 170·63fr. per kil. The service during 1879 cost some 1,110,351fr. more than it yielded; but fully one-third of the expenses and work seem to have been spent upon the gratuitous despatch of official telegrams.

"The Condition of Nations."—This is the title of a work by G. W. Kolb, translated by Mrs. Brewer, with notes by Mr. E. W. Streeter, containing a mass of statistics relating to the nations of the Earth. We have looked carefully through the work, hoping to find some useful information; but, like all other works of its class, it seems to be years out of date before it is printed. Let us take a few examples. The statistics of English telegraphs are given on page 108, but we find nothing more recent than 1878, when 22,477,921 telegrams were sent; of the English Colonies the latest figures are for 1877, for France 1877, when 12,422,112 telegrams were sent, bringing a revenue of £800,688; the same for Germany and for Hungary, but we find statistics of Russia for 1878. At that time Russia had 2,516 stations, sent 4,710,120 telegrams, at a cost of £823,956, receiving £1,099,148. Italy, in January, 1878, had 15,918 miles of telegraphs, with 50,050 miles of wire, also 110 miles of cable. We might continue

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to quote through the entire book of nearly 1,000 pages. The title page of the book says, "translated, edited, and collated to 1880;" the preface says, "and brought down to the actual present from authentic sources." We have found these statements slightly delusive, and cannot but consider that a work of such a size, published in 1880, should at least have been correct to the *end* of 1878, and it would not have been very difficult to have given many statistics relating to 1879. A large part of the telegraph statistics could have been corrected by the perusal of a copy of the *Journal Télégraphique*.

Lightning and Colliery Explosions.—Mr. Canning of the Gas Works, Newport, Mon., visited the Risca pit on the day after the disastrous explosion in July last, and became suspicious, from the statements of residents in that locality, that the accident in question was due to a discharge of atmospheric electricity into the mine. During the following month a series of experiments were instituted to determine the action of electrical currents in wires when surrounded with explosive gaseous mixtures. The experiments, from their simplicity, can be easily repeated by any one desirous of satisfying himself of the accuracy of Mr. Canning's observations. He used an ordinary induction coil and three Grove's cells for the production of the electricity. The wires from the coil terminated in small brass knobs. When the coil was connected up in the usual way, a stream of coal gas from a burner attached to a flexible tube was ignited on approaching the insulated wire. When the wire was not insulated, the same effect was produced, with the difference that in this case the ignition was effected by a lump of coal placed in contact with the wire. Small coal in the neighbourhood of the charged wire gave rise to a continued exchange of sparks. Finally, a box containing an explosive mixture of gas and air was exploded by the electrical discharge between a wire and a quantity of coal dust sprinkled over the bottom of the box. This evidence appeared so conclusive to Mr. Canning that, in conjunction with Mr. Thomas, he has obtained a patent for a protecting roof to cover colliery heads, to prevent direct or induced electrical discharges taking place in the winding wire, and also for a discharging apparatus for taking off electricity from such wires when the roof is not used. It will be remembered that Mr. W. H. Preece expressed his conviction that lightning was the agent that brought about the Risca explosion, and he has also stated his opinion concerning the danger of introducing the electric light, or, indeed, any apparatus requiring intense electrical force, into mines where fiery mixtures of hydrocarbon gas and air may be suspected.

The Two New American Cables.—The *New York World* states that it has been definitely settled that two new cables, to be controlled in America and not in England, will be laid, and that their construction will be proceeded with at once by Messrs. Siemens Brothers. That paper also publishes the following correspondence on the subject between Mr. John Pender, M.P., the Chairman of the Direct Cable Company, and Mr. Jay Gould:—

"London, Dec. 11.

"Have just returned after eight weeks' absence in the Mediterranean, where I have been endeavouring to give an international character to the whole of our system of submarine telegraphs, and with considerable success, an idea which I am anxious should be participated in by the Great American telegraph system. The French cable, properly worked, should meet all the requirements of your own Company for the moment. To spend more money in laying new cables at present would be equally disastrous to the new as to the present systems. I am hopeful that the French cable will be put into a thoroughly efficient working state so soon as the agreement with us is ratified. I shall do all in my power consistent with any existing obligations in order to bring about such an arrangement as will satisfy the requirements of your traffic. My visit to America is only delayed. It is my full intention to come out in the spring. The French Company's meeting for confirmation of the agreement is to be held Jan. 12 next.

"John Pender, London.

"Jay Gould, New York."

"New York, Dec. 12, 1880.

"Your despatch received. As an evidence of my entire friendliness to your interests, I carefully communicated through Mr. Ward to you some weeks since the concessions our large interests on this side required from the existing cables, and at the same time I informed him that unless these were granted we should lay our own cables. Having received unfavourable responses I accordingly opened subscriptions for two new cables. The entire amount is subscribed, and we shall proceed to lay them. At the same time I cordially reciprocate your sentiments as to international telegraphy, and will do my share towards its vigorous and rapid development by laying independent cables.

"Jay Gould, New York.

"John Pender, London."

With reference to the foregoing the following further correspondence has been published in the daily press:—

"Sir: I observe in your paper of this date two telegrams between Mr. Jay Gould and myself extracted from the *New York World*. I may mention that these two telegrams were confidential, and published without reference to me. I have, however, no objection to their publication, but think it only right that the same publicity should be given to a further reply I sent on the subject, so that those who may be taking an interest in Mr. Gould's cable projects may be made aware of the offers I have repeated to him and the warning I have given.

"I send you a copy of the telegrams in question, and shall be glad if you will publish them.—I am, yours faithfully,

"John Pender.

"The Direct United States Cable Company (Limited),
"52, Old Broad-street, London, E.C., Dec. 29, 1880."

(Copies of Telegrams.)

"Dec. 22, 1880.

"Fuller, London, to Ward, New York.

"I have shown your telegram to Mr. Pender, and he wishes you to thank Jay Gould for his kind consideration, and inform him that he reciprocates this most fully, and cannot point to better evidence of this feeling than to the telegram showing Jay Gould how he could avoid a loss of £700,000 or £800,000 in not laying his proposed cables, by securing for his Company all the advantages that he could possibly derive from two new cables, and without incurring the hostility of existing companies. Mr. Pender suggests that before he commits himself he should consider carefully the agreement existing between the American Union Company and the French Company. If he is wise he will have that question settled before he decides to lay any cables, and Mr. Pender repeats to Jay Gould that he could obtain for his Company the service certainly of one cable, and of two cables if necessary."

"Dec. 24, 1880.

"Ward, New York, to Fuller, London.

"I read message to Gould. He said it was too late to alter his arrangements, and he could say nothing more on the subject."

A contemporary, commenting on this correspondence, says:—"Perhaps there is nothing new in Mr. Jay Gould making a dash at a grand project, but we believe it is something novel to find the keen-witted Yankees subscribing capital for an American cable, yea, a pair of them. "The entire amount," says Jay Gould, "*is* subscribed, and we shall proceed to lay lay them" (the cables). We hope they will. It will serve them right. Two new cables to America, and the Americans making them at their own expense!"

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CORRESPONDENCE.

THE TWINKLING OF THE STARS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: This ill-explained phenomenon occurring with remarkable vividness in this tropical sky has forced upon me the idea that something of great importance must result from the application of the photophone thereto. By the combination of a sensitive photophone with one of our colossal telescopes something of thrilling wonder may be revealed. The statement that the "stars sang sweetly" may at least become a literal fact, and a new science established. For this "astrophony" would probably be the most suitable name.—Yours, &c.,

Singapore, 8th Dec., 1880. J. C. C.

[Messrs. Bell and Janssen have experimented somewhat in this direction with the newly devised instrument of Professor Bell.—Ed. *E.*]

WHAT IS ELECTRICITY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Seeing that Mr. Gordon has been unable to challenge the accuracy of my statements concerning the capability of an insulated gas flame to show in which direction a current of electricity is moving, and that he has been unable to defend the statements in his book about there being two electricities, and prefers to keep silent as long as the first edition of his book has not been sold off, I move on to notice the second subject in his letter to you, page 283, Vol. V., namely, his remarks on my experiment of 1839 with the insulated Leyden jar, giving a shock while charged with positive electricity externally and internally. That your readers may understand the true object of the experiment it is necessary to look in the first place to the state of the science of electricity at the date the experiment was made and published. For this purpose I turn to the writings of Faraday, under date 1837, paragraph 1169, "Can matter either conducting or non-conducting be charged with one electric force independently of the other, in any degree, either in a sensible or latent state? [1176] On searching for such cases I cannot find one. Evolution by friction, as is well known, gives both powers in equal proportion. [1177] Charge always implies *induction*, for it can in no instance be effected without; and also the presence of the *two* forms of power, equally at the moment of the development and afterwards. There is no *absolute* charge of matter with one fluid. [1178] Induction appears to be the essential function both in the first development and the consequent phenomena of electricity." The foregoing remarks by Faraday are similar to the writings of Du Fay and other believers in two electricities. These opinions were shown to be false and rendered untenable by the publication, in 1839, of my two experiments, the one with the insulated gas flame, showing the direction in which currents of electricity move, the other the insulated Leyden jar, giving a shock when charged externally and internally by different quantities of electricity taken from the prime conductor of an electric machine. If the published account in 1839 of these experiments had received at the hands of Faraday and other electricians (to whom copies of the publication were sent) the attention which it ought to have received the fact of there being only one electricity would have been long ago publicly acknowledged, and Mr. Gordon and others would have been saved from writing much erroneous matter on this subject. In Vol. I., page 17, Mr. Gordon writes, "When electricity is generated by friction equal quantities + and — are always produced. The following experiment illustrates this fact. Place a friction electric machine on an insulating stool, and connect the rubbers to the conductor by a wire. However rapidly the machine is worked it will not even cause a divergence of the leaves of an electroscope attached to the conductor. This is because the negative electricity produced on the rubbers exactly neutralises the positive produced on the glass." If these statements of Mr. Gordon are true—first, that equal quantities of electricity are always generated by friction; second, that the negative electricity produced on the rubbers exactly neutralises the positive electricity produced on the glass, when the two are joined together by a wire there must be a point somewhere midway between the conductor and the rubbers at which the neutralisation of the two electricities takes place in the wire. Let us see if this is true, by cutting the wire at the central point between the conductor and the rubbers. On separating the wires a short distance electricity will be manifested. Is this the neutralisation of the two electricities which is taking place? According to Mr. Gordon's statement, and the theory of the two electricities, the two should there be meeting and neutralising one another. If this allegation be tested by the insertion between the ends of the wires of an insulated gas flame, it will be immediately bent down at right angles by the electricity, and the bending down will be to the side which indicates that a current of electricity is going from the conductor to the rubbers, and that there is no process of neutralisation whatever taking place between two electricities. On the contrary, the direction of the flame indicates that there is a current of one electricity which is making a continuous circuit through the machine and the wires, and that there are not two electricities developed by a friction machine.—Yours, &c.,

JAMES JOHNSTONE.

Craiglockhart Hydropathic, near Edinburgh,
28th Dec., 1880.

TELEPHONIC.

A correspondent writes that Mr. A. V. Kinsey will find information of the telephone in Count du Moncel's "Telephone, Microphone, &c." (C. Kegan Paul and Co.), and "The Telephone, &c.," by G. B. Prescott (Messrs. Spon).

THE MICROPHONE, 1880.

The interesting experiments instituted by Mr. James Blyth of Edinburgh immediately upon the discovery of the microphone appear to have directed the attention of scientific men in that city to microphonic research to a quite exceptional degree. *The Proceedings of the Royal Society of Edinburgh* for the past year, which are now before us, contain no fewer than six communications on this subject—called indifferently telephony or microphony, but which apparently are all microphonic. It is hard to say in some cases where microphony ends and telephony begins; but the earlier experiments here referred to relate chiefly to sounds produced by expansion and contraction under varying temperatures, or by loose points of contact, and are only indirectly connected with the special form of sound transmitter called a telephone. The several papers now published in the Royal Society's (Edinburgh) volume of proceedings are of such interest that we will endeavour to give our readers the substance of them in a single article—a separate reprint of them would far exceed the space we could afford.

As in the earlier instance, Mr. Blyth seems to have led the way to a new departure. Following up the experiments before alluded to he succeeded* in producing currents by the friction of conducting substances, and then employed these currents for producing sounds in the usual manner. The currents so produced agree in direction with thermo-electric currents, and the greatest current is got, as might be expected, from antimony and bismuth. The mere rubbing of two suitable conductors in a circuit will produce sound in a telephone included in the same circuit; and this led Mr. Blyth to construct a small dynamo machine on that principle, consisting of a revolving cylinder of bismuth in contact with a plate of antimony. Wires led from these substances respectively, and, including a microphone and telephone, enabled him to hear sounds actuating the former just as in cases where a battery is employed. Acting on a hint suggested to him when using a sharp metallic point instead of the horizontal plate, Mr. Blyth set about constructing a receiving telephone by means of a rotating bismuth cylinder, against which was pressed a fine wire, bent at right angles, and attached to the disc of a phonograph mouthpiece. Four Bunsen cells were put in the circuit, as also a microphone affixed to a violin, but no telephone. On playing the violin and rotating the cylinder the music was reproduced at the disc loudly enough to be heard all over an ordinary room. This effect is analogous to that of Edison's loud-speaking telephone; but, Mr. Blyth remarks, the explanation of their action must be different if electrolysis be the cause of variation in Edison's instrument, as no electrolysis takes place in Mr. Blyth's. Variations of the heat at the point of contact have a great deal to do with the actions of all microphones, Mr. Blyth thinks, and in general with all sounds transmitted from one loose contact to another.

In the following month† Professor Chrystal describes how he discarded the rotating thermo-electric arrangement, substituting the direct action of the current upon suitable thin wire attached to the membrane of a toy drum. We may here remark that Mr. Preece, in London, had hit upon the same device about the same date—perhaps a little earlier. Professor Chrystal's arrangements were almost identical with those of Mr. Preece‡ [*Electri-*

* *Proceedings of the Royal Society of Edinburgh*, May, 1880.
† *Ibid*, June, 1880.
‡ *Proceedings Royal Society, London*, May 27, 1880.

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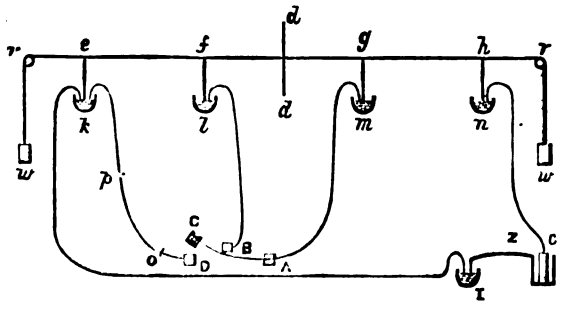
cian, June 5, 1880], and we need not describe them in detail. Various wires were tried, but the best results were obtained with platinum and palladium silver. With the same wire the effect increased with the current strength, and when producing a prolonged note the wire burst into a bright glow, especially if the note was a high one. Heating the fine wire externally by means of a lamp increased the effect slightly, and cooling with water or a blast of air diminished it. Professor Chrystal also confirmed Dr. Ferguson's previous experiments, proving that these sounds may be produced by currents of very small total heating effect, such as induction currents, but differs from him in attributing the effect solely to heat. Some obscure molecular cause had been suggested by Dr. Ferguson, to which Professor Chrystal urges that it is not the *whole* heating effect that is in question, but its rapid *variation*.

At the next following meeting of the Society* Dr. Ferguson replied, in support of his opinion, that the effect was not due exclusively, if at all, to variations of temperature, or, rather, in explanation of his holding that opinion. He held, with De la Rive, that the sounds were magnetic phenomena—that the molecules of the wire, in taking and losing the magnetic set, hit against each other, and emitted the sounds in question. As illustrating this view, though not entirely disproving that put forward by Mr. Blyth and Professor Chrystal, Dr. Ferguson arranged a very ingenious experiment, a diagram of which we give below. His chief objection to the thermal explanation was that the click which a wire emits when a current begins or ceases is inconsistent with the sluggish action of heat. This may be true for the click of a magnetic onset, but we think that Dr. Ferguson was wrong in saying that unless the increments and decrements of length are momentary they cannot affect a telephone disc. We know that the ordinary action of the telephone proves the contrary, for the currents then are not momentary but continuous and undulatory. However, we give Dr. Ferguson's experiment following in his own words:—"It struck me, on considering Professor Chrystal's reasoning, that if the sound be in the wire, the membrane disc, if placed in the middle instead of at the end of it, would still sound. If the sound was due to push and pull the two wires on either side would neutralise the effect the one of the other; but if due to internal commotion little change would be observed. So far as I have been able to ascertain the latter is the case:—



w r e f g h r w is a composite thread, consisting of a very fine platinum wire and fine cotton thread—*e f* and *g h* are the platinum parts. The thread is kept stretched by the two equal weights *w*, *w*. The middle of the thread is attached to the skin or paper disc of an ordinary mechanical telephone *d d*. At the ends of the platinum wires, wires of copper are soldered, which dip into mercury cups *k l m* and *n*; and a six-cell Bunsen battery is inserted at *c z*. At 1 is a current interrupter or microphone, the one used in this instance being a mercury break vibrating some six times per second. A B C D is a key, the handle of which is resting against B, but is capable of being pressed down against D, and then disconnecting B. In the one case both the wires *g h* and *e f* are included, in the other only *g h*—*e f* being shunted off, a platinum wire *p o* being interposed to keep the resistance equal. We have here in the first case two opposing receivers on the extension theory, or two sounders on the internal click theory. In the second case we have a receiver, the same as that of Professor Chrystal. But the sound emitted by the disc is much the same in loudness when both wires sound and when only one does; if anything I fancy it is in favour of the opposing wires. The two-pull telephone acts in fact as well as the single pull; and so far as I can interpret these facts, it is something other than the *pull* of the wire that emits the sound, and the single pull arrangement by no means proves the existence of sudden extensions and contractions in the wires. The conduct of a wire expanding instantaneously in every part may produce an effect like a molecular click, but if so its action must be something very different from the simple pull supposed."

* *Proceedings Royal Society, Edinburgh*, 1880, p. 700.

Early in July Professor Chrystal again appears with some further facts mainly relating to the anomalous behaviour of iron wires in these experiments. With other metals their variation of longitudinal extension, owing to heating, appears to be the explanation of their action in the wire microphone (or telephone). In soft iron wires the sound does not depend on their length and thickness, and other circumstances pointed to the suggestion that it is a consequence of their varying magnetism. Experiments with steel wires showed that when made white hot, and then tempered so as to deprive them of their magnetism, they were rendered incapable of giving off any sound; whilst on stroking them with a bar magnet they again emitted sounds quite distinctly. Similar experiments were made with nickel and with cobalt, and the effect of heating was in each case exactly what might be expected from their peculiar magnetic properties.

Consequent upon these disclosures Mr. Blyth was led to infer that a transmitter could be devised actuated solely by varying magnetism produced in a wire when caused to vibrate. His observations were communicated to the Society July 19th,* and were substantially as follows. In his first experiments he employed a Bunsen battery of four cells. The wire to be subjected to examination being placed in circuit, a fine iron wire 15 inches long was attached to it at right angles, the other end of which was affixed to the parchment disc of a mechanical telephone, and moderately strained. This was the transmitting arrangement (A). At the receiving station (B) an ordinary double-ear Bell telephone of small resistance was employed. It will be understood from this description that when the disc is vibrated, that portion of the circuit to which the disc is externally connected will vibrate also. When a fine iron wire nine inches long was the portion referred to any musical sound uttered into the mouthpiece of the mechanical telephone became distinctly audible at the receiving (Bell's) telephone B. Speech could also be thus transmitted. Reducing the battery power was found to have little effect upon the intensity of the sounds reproduced. The battery was then removed altogther, with this startling result, that the sounds could still be heard, though now very faint. The reason for this effect appears to be that the vibrations of the iron wire across the lines of force, due to the earth's magnetism, produces a current strong enough to work a telephone. We are here reminded of the fact, first mentioned by Mr. Bell, that his telephone could be worked by a soft iron bar in place of the magnetised bar usually employed. But in Mr. Blyth's experiment, even this bar is dispensed with, and the magnetic variation is set up by the movement of a bit of wire in the circuit. This account of the phenomenon was confirmed by further experiment. The battery current being again introduced in the circuit, and a horse-shoe magnet with the line of its poles at right angles to the wire was suspended over and quite close to it. A manifest increment of sound resulted from the approach of the magnet, and a decrement followed its withdrawal.

Mr. Blyth also noticed that in the case of fine iron wires inserted at A the sounds were transmitted equally well whether the mechanical telephone was attached to the middle as above described, or at the end of, and in the same direction as the wire itself. This observation is of importance as confirming Dr. Ferguson's opinion that the effect is not produced by variation in the resistance of the wire, caused by the bending to and fro of its points of attachment to the circuit wires. Thick iron wire gave very faint sounds, but on being heated by a flame to a dull red heat the sounds became louder. One puzzling result however followed, for on inserting first thick and then thin platinum wires their behaviour was the same as the magnetic iron wire. The same was the case with cobalt; while copper and aluminium gave rise to no sound whatever.

In explanation of some at least of these phenomena, Mr. Blyth suggests:—"(1) Varying magnetisation in the wire, especially the iron wire, caused by strain; (2) variation in the temperature of the wire, caused by the cooling effect of the air as the wire vibrates; (3) alterations of the resistance caused, by the varying strain to which a vibrating wire is exposed." Our readers will look forward with interest to the results of further experiments from the same quarter, and we shall give them publicity as soon as the information may reach us.

SQUABBLES IN AMERICA.—The Pennsylvania Railroad Company have notified the Western Union Telegraph Company to remove their wires along the railway. This, however, the Western Union Company have declined to do, maintaining that their rights are secured by contract, and have applied for an injunction to restrain the Pennsylvania Railroad Company from interfering with the wires. The case excites immense interest, as it concerns the great trunk telegraph route, with which the principal points of the North and South are connected.

* *Ibid*, p. 730.

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THE ELECTRICIAN.

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1880.

ELECTRIC LIGHTING.—The year has been one of great progress in every stage of electric lighting; apparatus has been improved, extension has been great, and public opinion has been educated. The only company of importance existing at the commencement of the year was the *British Electric Light Company*. This company are the sole licensees of the Gramme machine, a machine which has hitherto held the first place, theoretically and practically, as an electric light machine. It would be superfluous to tabulate the whole of the work of the company during the year, it will be enough to state what is now in hand or to be completed in the immediate future. We may here say that this company does not pin itself to the use of any one particular kind of apparatus. It says, we exist for the purpose of supplying the electric light, and we will give you the best in the market. Hence, at one place you find the company using the André lamp, at another the Brockie lamp, at a third the Crompton lamp, and so on, considering the local conditions and acting accordingly. The following works are in hand:—The Victoria Station, Lancashire and Yorkshire Railway, Manchester; Cannon-street Station, South Eastern Railway, London; the Warrington Guardian Printing-offices, Messrs. Lister and Co's Dye Works, Bradford; the Cymmer Coal Company, Newport, Monmouth; Messrs. Cox and Sons' Lace Works, Nottingham; the Clyde Paper Company, Glasgow; Messrs. Laird Brothers, Birkenhead; Seafield Hydropathic Establishment, Waterloo, near Liverpool; Messrs. John Stewart and Son, Blackwall Iron Works; Messrs. James Muspratt and Sons' Chemical Works, Widnes; Messrs. J. B. Saunders and Co., Cardiff; Mr. Sydney F. Walker, Nottingham (for Colliery); Land Reclamation Works, Ennis, Co. Clare. As we have also recently noticed, Liverpool has accepted a tender from this company for lighting several of its principal streets. One noticeable feature in relation to the company is, that its work has been and is, successfully carried on with a comparatively small capital. It reflects great credit on the management that so much work should be performed, a dividend paid, and no fuss made.

The electric lamp that has found most favour with the British public is that designed by Mr. Crompton. In 1878 this lamp was used in two places, in 1879 four more were added to the list, whilst in 1880 the makers have been unable to produce lamps fast enough. The British Electric Light Company have used these lamps at the Glasgow and South Western Railway, and the St. Enoch's Terminus Stations at Glasgow, at the Quay at Copenhagen, at Mr. Betts's (Manchester), at the Mersey Tunnel Works, at the Furness Railway; at Bradford Waterworks, in the ss. "Chimborazo," on the London and North Western Railway Goods Sidings at Liverpool, by the United States Electric Lighting Company, by Messrs. Mawson and Swan (Newcastle), Willoughby Smith, W. Spottiswoode (President of the Royal Society), at the Alexandra Palace, by Messrs. Ketson at the Airdale Foundry (Leeds), by the North British Railway at the Queen-street Terminus, at the General Post Office (Glasgow), at the Blytheswood Arcade (Glasgow), by the Woodbury Photographic Company, by Messrs. Brown Brothers, Rosebank Foundry (Edinburgh), by Messrs. Tate Brothers (Silvertown), by the India Rubber and Gutta Percha Company (Silvertown), &c. The light is also being used at the Bricklayers' Arms Station of the South Eastern Railway, and at the King's Cross Station, Great Northern Railway. We understand that in order to meet these heavy demands Mr. Crompton is building a large workshop for the purpose of manufacturing the Bürgin dynamo machine as well as his lamp, and on the completion of the works he hopes so to economise labour and time as to enable him to considerably reduce the first cost of electric light apparatus. A new pattern of lamp is to be made that will burn thirty hours without change of carbon. The energy with which Mr. Crompton has pursued the subject, and the full belief he has in the ultimate success of the electric light have done much to improve the tone of public opinion. His constant efforts to reduce the cost have resulted in a considerable cheapening in the carbons. At the beginning of 1880 the cost of carbons in his lamp was 2d. per hour, at the end of 1880 the cost was reduced to 1·25d., and in some cases still more closely to the 1d., without interfering with the quantity or quality of the light. Our daily contemporaries are stating that on board Russian vessels using the electric light many accidents have occurred, similar to, if not so violent, as that which caused the death of a man on board the "Livadia." It is said that a commission has been formed to inquire into the subject. We may point out that, to the best of our belief, these accidents have all occurred with the use of alternate currents, and that no accident has happened with the Crompton lamps and continuous currents.

Another lamp rapidly forcing its way into public favour is that invented by Mr. Brockie. A number of these lamps are in use in Glasgow, in carpet factories, paper mills, ship-building yards, &c.; whilst here, again, the manufacturers are unable to turn out the apparatus fast enough. Special dynamo machines, we believe, of the Gramme type, have been built to supply the current to six or eight lamps

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per machine in series. The British Electric Light Company have supplied some fifteen of these lamps in Manchester, and, we understand, have adopted this lamp for use at the Cannon-street Station on the South Eastern Railway. This lamp has been specially designed for factory use, but the inventor is at present considering certain modifications necessary to adapt it to street lighting purposes. It will be remembered that the lamp is one of the type which adjust the carbons periodically.

Quite recently the Anglo-American Brush Light Corporation has been floated on a capital of £800,000, with a first issue of £400,000. The Brush system has been extensively tried in America. It has recently been used in Broadway, New York, and is spoken of as successful. For a new company its success in England has been wonderful. It remains, however, for the future to show that the "income" is commensurate with the "expenditure." A company with such an enormous capital must necessarily transact a large amount of business to make both ends meet. Our position with regard to all these systems of lighting is well defined. We are anxious to possess information which the various inventors and companies are not at all anxious to give. Of course they are right and we are wrong. The information must come sooner or later, and the data upon which to calculate the cost will inevitably become public property. Any person who desires to compare the various lights will in the course of a few days be able to do so. The Brush system will be seen at Paddington, at Charing-cross, and at the Great Eastern Railway Company's Terminus, Liverpool-street; the Crompton lamp at King's Cross, and the Brockie lamp at Cannon-street. Unfortunately, the "City" authorities blundered in their endeavours to give a fair chance to the several systems, and the future may show that such blundering is an expensive luxury.

The recently introduced Jamin light, under the charge of Mr. J. A. Berly, C.E., has since May been adopted by Messrs. Samuel Bros., Ludgate-hill, and the Panorama Company in Leicester-square. The total number of lights at work, or being fitted, is 60, but the light is used more extensively in France, some 140 lights being at work or in hand, whilst in Holland there are 26, and in Brazil 8, making a grand total of 234, all fixed between May and December.

We regret that our review of electric lighting is incomplete, inasmuch as we have little authentic information of the work of Messrs. Siemens. No doubt the incidental changes through the conversion of the "house" into a "limited', company have prevented the necessary details reaching us. Meanwhile, we have every reason to suppose that Messrs. Siemens have been extremely busy in the supply of apparatus throughout the past year, not only in England, but over a far wider area—we might say the whole world. Among the most prominent and successful of their undertakings, however, we may mention the lighting of the Parade at Blackpool, the New Harbour at Holyhead, and the Royal Albert Docks, London. The light in the latter place is, we understand, gaining more and more favour daily.

The Jablochkoff light seems to remain at rest, and is, we suppose, thankful.

Thus far we have referred to the more or less well known names before the public; there are others, perhaps not less well known, that we must briefly mention. Mr. Edison, according to the newspaper reports, ought long since to have given public demonstrations of his success. As we anticipated, success in this direction is not to be achieved by Mr. Edison without labour and knowledge. He has had to pay the penalty of trusting to the "penny-a-liner," or has been used by the keen-sighted speculator. We have reason to suspect that during his experiments he has done a large amount of good work that has not yet been published, and in a measure has been successful. Although we have been taken to task by our American contemporaries, we must state our conviction that Mr. Swan of Newcastle, who twenty years ago experimented with incandescent strips of carbon, deserves and will receive the honour due to the successful experimentalist in this direction. We have so recently described Mr. Swan's lamp that there is no need to mention it at length. The experience accumulating regarding its trials is so uniformly good that we may reasonably hope to see the commencement of a new era for the lighting of interiors.

Messrs. FitzGerald, Heinricks, and Perry have severally patented improvements in magneto and dynamo machines, taking the Gramme as the starting point. Mr. J. E. H. Gordon has devised an entirely new type of lamp, which he hopes will soon be ready for public trial. M. Maxim, following somewhat in the footsteps of Mr. Swan and Mr. Edison, maintains that he has devised a vacuum lamp, and the means of strengthening and rendering homogeneous the carbon strip at one and the same time. The value of these machines and lamps is the question of the future.

Telephonic Telegraphy.—During the past year the Bell and Edison Companies united, and both before and since the amalgamation the increase in the telephonic systems has been continuous. The illegality of the work of the telephone companies has been so far settled in a court of law that, pending an appeal, the Government has gained its contention on every point. We have never seen how the result could be otherwise. Public opinion is very like a weather-cock, and given a heavy fall of snow at a fairly high temperature, followed by a low temperature, and a gale of wind, bringing some scores of those ancient posts and wires about the ears and heads of householders, opinion would at once condemn the government, local or national, that countenanced the putting up of such wires. It seems to us axiomatic that telephony must necessarily be a monopoly, and we would gladly receive a reply to the question, Will telephonic monopoly in the hands of the Government or in the hands of a private company be most compatible with public interest? At any rate, experts state that the instruments now offered by the Government are the best in the market. We think the cost of the convenience too great, but it is cheaper than the company affords.

Discovery.—Professor Graham Bell, in conjunction with Mr. Tainter, has devised an apparatus, which he calls the "photophone," enabling audible sounds to be reproduced at a distance without any more material connection between the sending and receiving apparatus than the substance conveying light waves. Discovery is far from exhausted in this direction. A writer in the *Engineer*, more than two years ago, pointed out that this field was almost a perfect blank, offering a fine opening for investigation. We have now apparatus reproducing sound waves with (1) a material connection, (2) by the connecting medium of light waves. What we now look forward to is the reproduction, not of sound, but of light waves. Is it an impossible task?

The Society of Telegraph Engineers and of Electricians.—This is the new title of the society generally known as the Society of Telegraph Engineers. At the meeting when the change of title was agreed to, the president

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stated that the council had duly considered a number of suggestions, the result being that the above title was recommended and supported. Our views upon the matter have long since been freely given, and we can only regret the one-sided and illogical alteration. It now goes forth to all the world that the "telegraph engineer" of the nineteenth century is not necessarily an "electrician." Some few men have long deplored this as a fact, and we can only regard the council agreeing to such "title" as a tacit acknowledgment that the preponderating members of the society are telegraph engineers, and *not* electricians. Mr. Varley's remark during the discussion of the question, that a movement was on foot to form a Society of Chemical Engineers had scarcely any bearing on the question, as most of those present at all conversant with chemical matters knew that the idea of the men anxious to form the new society was to make it a society of "Manufacturers of Chemicals," and that the promoters, instead of being ignorant of "chemistry," are among the best exponents of the science. Chemists first, manufacterers afterwards—we should like to say electricians first, then telegraph engineers.

Some valuable papers have been read before the society during the year, but the most important incident is the completion of the Ronalds Library catalogue, the binding of the books and pamphlets, and the arrangements for the use of the library. Mr. A. J. Frost, the librarian, has kindly taken the trouble to forward us the rules to be observed in connection with the library, and that of Mr. Latimer Clark, which is also offered for the use of members. Mr. Frost hopes to make the library of great value by paying attention to the convenience of his readers, and we trust his energy will meet its reward in a large number of readers. The following are the rules to regulate the library:—

1. That the library be open to members of all scientific societies, and on application to the librarian to the public generally.

2. The library is open daily between the hours of 11 a.m. and 8 p.m. except on Thursdays and Saturdays, when it closes at 2 p.m.

3. The library will be closed from August 15th to September 15th, both inclusive, and on all public holidays.

4. The library is to be used for reference only, and no books, pamphlets, or patent specifications are allowed to be taken from the library.

5. All works are to be returned to the librarian or his assistant, and are not to be replaced on the shelves by the readers.

From the 1st January the collection has been opened, practically as a free public library, till eight in the evening, for four days in the week. The library contains all the principal scientific periodicals, and arrangements have been made to have all the published specifications relating to electricity immediately after publication. Mr. Latimer Clark has placed his magnificent collection of electrical works at the disposal of the members of the society, so that they can be seen at his office on application.

PATENTS.—We are told that during the past year the number of patents taken out is greater than in any previous year. It is almost impossible without a careful consideration of every patent to say exactly how many refer to electrical matters. A contemporary with its usual disregard of facts states that 270 electrical patents were taken out up to December 4. We have at some trouble compiled the following list, but must mention that the sum total is no criterion of the number of patents taken, because many are given under two or more headings in the official list:—

SUBJECT OF PATENTS.	NO.
Compasses	5
Electricity	91
Electric light	58
Electro-magnetic machines	14
Insulators	15
Signals, Alarums (about)	30
Telegraphs	88
Wire (Telegraphic and Telephonic) (about)	13

Electricity in some form or other is incidentally used in a large number of other patents—such, for example, as those inventions devised to light a large number of gas-burners simultaneously, to indicate the level of water, the speed of mechanism, governors, &c. It is but just to say that most of the "patents" will be found to be communicated, which means they are the work of others than Englishmen.

EDUCATIONAL.—The City Guilds Institute has been very successful in its work for the year; the Society of Arts arranged a series of Cantor lectures on a subject interesting to telegraphists, and has arranged another series to be given in the spring by Professor Adams, F.R.S.; the School of Telegraphy offers special facilities for preparation of submarine work; the Science Department continues its usual course; and, altogether, we may say that if anyone desires information on electrical subjects it can be obtained with no great expenditure of money and with little inconvenience or loss of time.

EXPORTS.—A tabular statement of the telegraphic wires and telegraphic apparatus exported for eleven months follows; also the corresponding exports for the previous year:—

	1879.	1880.
Month ending Dec. 31 ...	£20,660 ...	—
,, ,, Jan. 31 ...	40,719 ...	£31,813
,, ,, Feb. 28 ...	24,685 ...	54,302
,, ,, Mar. 31 ...	35,200 ...	167,564
,, ,, April 30 ...	20,990 ...	48,212
,, ,, May 31 ...	282,450 ...	71,279
,, ,, June 30 ...	158,412 ...	43,306
,, ,, July 31 ...	287,231 ...	229,640
,, ,, Aug. 31 ...	584,285 ...	32,149
,, ,, Sept. 30 ...	64,645 ...	441,768
,, ,, Oct. 31 ...	412,201 ...	64,030
,, ,, Nov. 30 ...	570,572 ...	24,840
Total.....	£2,502,050	£1,208,903

NEW ELECTRIC MOTOR.*

BY WILLIAM WOODNUTT GRISCOM.

An electric motor, as the name indicates, is an engine for converting electricity into mechanical force. This is done most efficiently through the medium of electro-magnetism, and the honour of inaugurating the movement which has led to the utilisation of this force as a motive power belongs to our own Professor Henry. His first paper on this subject appeared in 1831. In the following year Salvatore dal Negro constructed his motor and described it in detail. The first electric motors were rude machines, about as efficient as Hero's steam engine, but it hardly took the world more years to perfect the one than it required centuries to complete the other. Dal Negro's motor consisted of a fixed electro-magnet, which, by suitable interruptions of the electric current, alternately attracted and released a lever by which the mechanism was driven.

In 1835 Professor Jacobi, of St. Petersburg, constructed an electric engine at the expense of the Czar Nicholas, with which, after four years of further experiment, he was able to drive a twelve-oared boat against the swift current of the Neva at the

* Paper read before the Franklin Institute Nov. 17th, 1880.

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rate of three miles an hour. His enormous battery consisted of sixty-four cells, containing twenty square feet of platinum.

This was in all respects an apparent failure, and the philosopher was thoroughly disheartened while standing unwittingly on the threshold of a brilliant success. In the first place, he attempted the impossible in trying to get a great power economically from any battery; and, in the second place, no powerful battery had yet been invented. But his engine was an excellent one, and the subsequent inventors failed to equal it until Gramme, of Paris, discovered that one of his own dynamo-electric generators would act in the reverse direction as an admirable motor.

The interval between 1839, when Jacobi's motor was abandoned, and 1870, when Gramme's machines came into notice, was occupied by a large number of inventors, who brought to their work a world of ingenuity and all the learning of all the sciences save one, but that one was the only key to success—*electro-magnetic induction*. In the meanwhile Mr. Joule, himself a former seeker after this nineteenth century philosopher's stone, dashed the hopes of his co-inventors by his demonstration of the Conservation of Energy. This magnificent work, the grandest perhaps in the history of science, was immediately made the basis of a series of experiments, which it would be out of place to detail here. Suffice that Mr. Joule proved to the satisfaction of all scientific minds that the mechanical energy of the electrical current, produced by the consumption of one pound of zinc in a Daniell cell, is equal to 1,106,160 pounds raised to the height of one foot; in a Grove cell, which has $1\frac{3}{4}$ times the electromotive force of Daniell's, to 1,843,600 pounds raised to the height of one foot, or, in the sulpho-chromic acid battery now before you, which has double the electromotive force of a Daniell's, 2,212,320 pounds raised to the height of one foot. Dr. Scoresby and Mr. Joule state their conclusions in the following sentence: "Upon the whole we feel ourselves justified in fixing the maximum available duty of an electro-magnetic engine, worked by a Daniell battery, at 80 pounds, raised one foot high for each grain of zinc consumed." This is about half the theoretical duty. In a Grove battery the same proportion would give 144 pounds, and in the sulpho-chromic battery 160 pounds, raised one foot high for each grain of zinc consumed. This result was immediately compared with the duty of the best type of steam engine per grain of coal, and it was found that one grain of coal lifted 143 pounds one foot high. But zinc, at the most favourable computation, costs ten times as much as coal, and the force it yields is, therefore, as 143 is to $\frac{160}{10}$, or about nine times as costly.

The conclusion instantly drawn by the scientific world was that electricity produced by the consumption of zinc can never compete with steam, but it is the purpose of this paper to collect certain facts which will show that this conclusion is erroneous.

History is teeming with instances where noted scientific men declared that there was nothing attainable beyond their immediate vision, and proved with sarcastic argument and brilliant syllogism that further advance in certain directions was impossible. So it was with the steamship. An eminent scholar and mathematician, some fifty years ago, proved beyond the peradventure of a doubt that an ocean steamship was an absurd dream. His calculations showed that one could not be built large enough to carry her own coal across the Atlantic. And so these gentlemen, having proved that electricity produced by zinc is nine times as costly a source of power as steam produced by coal, predict that electric motors can never usefully compete with steam engines. Now, man-power, according to the tables of a well-known English engineer, is one hundred times as costly as steam; nevertheless there are several circumstances in which we prefer men. It is certain that we would never employ men if we could get a steam engine to do the work more cheaply, and it is equally certain that we would not use electricity where steam was applicable. But steam is *not* applicable, for reasons which will be given later in detail, to work in which we require a small amount of power in constant readiness for action. In these cases—such as jewellers' lathes, dental engines, and the various tools of small machine shops, which employ but a small force of men—we have never been able to find a source of power adapted to the work which, if not as cheap in proportion as large steam engines, should yet be more economical than human energy. The fact is that whereas, according to Joule, the best electric motors are nine times as costly as steam power, human energy is eleven times as costly as electricity. And, inasmuch as human energy, which is one hundred times as costly as steam, is frequently preferred to steam engines, *a fortiori* electricity will often be preferred to steam; and it will require no argument to show that the human energy thus saved from exhaustion in the exercise of brute force can be devoted to a higher use.

(TO BE CONTINUED.)

CABLE-LAYING IN GUIANA.

BY J. MUNRO, C.E.

(CONTINUED FROM PAGE 82.)

The usual rate of paying out is about five miles an hour. Night and day the cable is running out of the ship at this rate, and extending behind in a slant through the water until it reaches the bottom, at a point varying with the depth, but often ten miles in the rear. A constant watch is kept on the cable in the tank to ensure its leaving the latter freely, for were several flakes to stick together and catch in the crinoline, such is the momentum of the moving ship that the crinoline would be torn up and the cable most likely snapped asunder and lost in the sea. To prevent any accidents on deck through this or some other cause, a man stands near the stern sheaves with an axe in his hands ready to cut the cable asunder at once and relieve the strain. The velocity of the cable and the strain upon it are also constantly noted.

In the electrical testing room a perpetual test is applied to the whole cable to detect any flaw that may break out in the insulator the moment it appears, and signals are exchanged every few minutes with the electricians left on shore to make sure that the copper conductor is intact, and that communication is kept up. The soundness of the insulator is certified by a spot of light from a mirror galvanometer on a darkened scale, and an electrician is told off night and day to watch this spot. So long as it remains steady on the scale all is right, and when relieved from his four hours' duty the watcher may write "O K" (telegraphic parlance for "all correct") in his log book; but should the spot suddenly fly off the scale something is wrong, a fault has broken out, and he at once rings the alarm bell. Then the officer on the bridge signals the engineer, the engines are stopped, the cable is restrained, and the ship brought to rest. There is much excitement on board, from the engineer-in-chief down to the sailors; for the fault may be overboard in deep water, two or three hundred miles behind the ship. In this case it will be necessary to cut the cable and buoy its end, then go back to where the fault is supposed to be, grapnel for the cable on the bottom, haul it up, and cut out the faulty piece. If it be within twenty miles of the ship, she will most likely proceed backwards, hauling in the cable again as she goes, until she arrives at the fault. On the other hand, the fault may be in the length of cable on board the ship not yet paid out, and little time or money need be sacrificed in getting it eliminated. The first thing to be done in any case is to cut the cable near the stern of the ship, and test the length in the sea and the length still on board separately, and in this way localise the fault. Several stories are told of faults having broken out while the weary electrician on watch had dropped off to sleep; and it is said of one green youth who was on duty when a fault occurred that he coolly reported in his log book at 1:15 a.m. "spot vanished"—and went to sleep until he was awakened at four bells by the man who came to relieve him.

While the electricians and engineers are on constant duty, observing all the symptoms of the cable, electrical and mechanical, the navigating officers are no less busy, fixing the position of the ship, by the sun during day, and the moon and stars during night. Soundings, too, are regularly taken every few hours to determine the depth and character of the bottom. The temperature of the water, and the velocity of currents, are also occasionally measured, in order to learn as much as possible of the place in which the cable is deposited.

The morning after leaving Pará we had paid out all the shore end, and were again off the mouth of the Amazon. It was a charming morning. The bottle-green sea was shot with sunbeams which illuminated its depths and showed the glistening silt-like motes. Here and there the olive surface was crested with the foam of breakers, or dappled with the purple shadows of the clouds. White gulls wheeled and gleamed under the cloudy sky like flecks of snow. The violet nautilus scudded along like a bubble before the light sea breeze, and thousands of medusæ, resembling Chinese lanterns, tumbled about at all depths. In the afternoon, shortly after dropping the pilot, we ran into one of the treacherous sand-bars which infest the mouth, and stuck fast, the screw churning up the sand and froth among the delicate pulsating medusæ, which seemed to have crowded round to look at us. The ship, which a moment before had been gliding like a sea-bird over the painted ocean, now lay as helpless as an iron box. All the efforts of the screw were unavailing to get us off the bank, so a kedge anchor was put out, and we waited for the evening flood tide. During the daylight which remained, a boat was lowered to buoy the cable, but the tide rose so rapidly that the boat was caught under the cable, and to prevent her being swamped the men on board were obliged to cut the cable, and in their alarm they cut on the wrong side of the buoy, so that the Para end was lost in the sea. That night a terrible squall of wind and rain came on; the "Hooper" creaked and strained and bumped every now and then against the bank. A very high tide was running up, and this, with the counter flood of the river running down, made the sea very rough. The shouts of the seamen and operations in the darkness, the raging waves, the lightning which flashed out of the gloomy sky in which a new moon was struggling, made a wild enough scene, and the shuddering and groaning of the huge ship as she was knocked against the ground added a spice of danger. About 11 p.m., however, just when the tide was at its full, the engines backed her off, and we were clear. Next day the ss. "Great Northern," the repairing ship of the Western Brazilian Company, sent to us from Para, recovered the lost end of the cable and the buoy for us, not without some difficulty, owing to the high sea which tossed the cutter like a cockleshell, and the sudden squalls which came down every now and again.

After this little episode all went well for a few days, if we except a false alarm of a "fault," which turned out to have been occasioned by some neglect on the part of the electricians stationed at Para, "the men at the other end," who generally come in for as much blame as possible on a cable expedition. If the men at the other end heard all that is sometimes attributed to them on board the ship, they might feel inclined to retort in language not quite Parliamentary; but it is useless to attempt to storm through a submarine cable, all the emphasis is lost

Mile after mile was run out day and night, until the stern tank was emptied, and it became necessary to shift to the tank amidships. The cable being all in one piece, this was effected by slowing the ship until the bight came up out of the empty tank, and straightened itself on the pulleys. It is generally a moment of some anxiety while the bight straightens, for

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it does so with a jerk, which is apt to overstrain the cable. On this occasion, while the chief engineer was rather anxiously leaning over the mouth of the tank to see the bight come up, it suddenly straightened out within a hair's breadth of his temples, and knocked off his hat. Had it struck a half inch lower it must have killed him on the spot.

The "doldrums," as this thunderous, moisture-soaked, equatorial belt of seas is called, is the proper place to study meteorological phenomena. All kinds of clouds, cumulus, cirrus, stratus, and their crosses are to be seen here almost any day of the year within the compass of the horizon spread out like a panorama. Squalls, thunderstorms, and waterspouts are of frequent occurrence, and some of the rainbows and tinted moon haloes are very beautiful. The sunsets are truly magnificent; and one can fancy how their gorgeous pomp may have helped to fire the Elizabethan imagination, and to foster the dreams of Eldorado, which lured so many of the early Spanish adventurers to their doom. The intensity of the sun's rays, and the pure vaporous clouds, are doubtless the cause of these grand atmospheric displays which, in form and colour, are enough to drive a Turner to despair. There is a wild grandeur and variety of shape in the clouds, and a splendour, ethereal delicacy, and strangeness about their colours and those of the sky rarely or never seen in England. Russet brown, scarlet, crimson, and golden tints prevail among the western clouds, which usually burn against a tender glow of apple green, lavender, and primrose light, or a flush of lilac or rose-coloured vapour, through which the white stars peep like diamonds studding some gauzy veil. Patches of cloud fire up, too, in the strangest manner in out of the way parts of the sky, and very frequently some fleecy cumulus opposite the golden sun glows like a great yellow rose. All the splendid colours of the sky, which fairly rival the hues of the dying dolphin, are faithfully reflected in the sea through all their fleeting shades, as the tropic day rapidly declines.

It was delicious to sit on deck in the cool evening breeze, and watch the brief gloaming pass into a brilliant night. There is something weird in the motion of a great ship in the twilight, when the dark sails flap athwart the starlit sky, and all sounds are hushed on board save the ripple of the water past her sides, or the whisper of the wind in the shrouds. The heavens were clustered with stars and nebulæ as on a frosty night at home. The planet Venus, hung like a great golden lamp in the north-west among purple bars of cloud, threw a broad beam across the sea like another moon, and even Sirius blazed so brightly as to cast a perceptible shadow. The ship, plunging through dark green seas dashed off sheets of luminous spray which gleamed along her bows like a furrow of new fallen snow, and streamed behind her in a ghostly wake.

Some portions of the open sea were so phosphorescent as to glimmer with a faint silvery lustre, brighter at some places than at others, according perhaps to the prevalence of the light-giving animals. In the fresh cool morning, before the golden sunrise tipped the slate coloured waves with gold as they heaved into its beams, we generally passed through fleets of mauve-coloured Portuguese men-of-war, rocking like soap bubbles on the surface of the sea, each attended by a retinue of tiny fishes which twinkled round him in the water like a school of white bait.

Flocks of milk-white flying fish rose every now and then from the bows, and pursued their curving flight, which resembles that of the mudlark, until they dropped again into the water; and here and there might be seen a whale spouting forth a cloud of spray, or rearing himself upright into the air so as to fall with a loud splash into the water. Droves of porpoises chased each other in sport through the waves alongside the ship, and seemed to challenge her to a trial of speed. Sharks were never absent from us during the whole of the way from Pará to Cayenne. These seas literally swarm with them, and we saw several twenty feet long. All day they kept following in the wake of the ship, as stealthy as cats, the sunny ripple playing in rings over their brown backs; and at night they could still be seen as great luminous masses in the phosphorescent water. It is their custom to follow ships for the garbage which may be thrown out to them.

One day as we were nearing Cayenne an unexpected piece of good fortune fell in their way. We had on board a little terrier dog, a worthless little cur, perhaps, but still intelligent and affectionate, as many curs are, probably because they so rarely meet with kindness that they are inclined if it be possible to over value it. It belonged, I believe, to the ship's boy, and was his only link with home, but seemed to have no business in a telegraph ship; nobody appeared to own it, and it led a very dog's life on board. Sometimes Bobby could be seen hirpling, as the Scotch say, on three legs across the burning hot iron deck, which he could barely tolerate; but he was oftener to be found curled up asleep on some out-of-the-way coil of rope. One day lured, no doubt, by the fragrant smell of the dinner being cooked, he ventured into the cook's galley, and speedily received a ladleful of scalding soup on his back. Stung with the pain, the little thing ran yelping madly round the deck, and a sailor, crying out in sheer wantonness that he was mad, laid hold of him by the tail and tossed him with a laugh overboard into the sea. For some time Bobby could not be seen, but presently he appeared at the surface looking like a drenched rat, and he instinctively turned towards the ship. He looked with wild, beseeching eyes at his old human companions who had crowded on deck to watch his struggles, and yelped out for their assistance in the most pitiful manner, as he swam manfully after us. But if Bobby believed that his old friends and patrons would help him in his desperate plight he was much mistaken. What is a dog's life that it should delay a telegraph ship for half an hour? So Bobby drifted behind with the swift current to his inevitable doom. Every time he rose on the long green swell we could see him still paddling for dear life after us, with his face straining towards us—a wretched little waif on the wide expanse of ocean. But at length we missed him, for the sharks had put an end to his miserable life at last.

Our original intention was to lay a direct line of cable from Para to Demerara, connecting in Cayenne on the way, by means of a short arm of cable branching out from the main line. The junction of these three cables was to be effected through the medium of a T-shaped piece of cable, composed of two short arms and a leg strongly braced together. After we had paid out 554 miles of Para cable, and arrived off Cayenne, we anchored for the purpose of laying the T-piece, in some 40 fathoms of water. The weather was rather stormy and the equatorial drift was running at the rate of three or four knots an hour, so that our operations were proceeded with under great difficulty. The first thing to be done was to cut and buoy the Para end, that is, the cable we had just laid, in order that we might the more freely submerge the T-piece by itself. An empty cask was lashed to the cable, to buoy the end. The lifeboat was then lowered and securely anchored, and the cable was seized by the men on board and lashed over her. When this had been done the cable was cut at the stern of the "Hooper," and the end cast adrift. In this position of affairs the lifeboat operated as a buoy, and when it was seen that all was secure, the ship's cutter was lowered to fetch off the crew of the lifeboat, all but two men told off to stay on board during the night and trim the beacon lamp. After a great deal of banging and swinging against the ship's side as she rolled and pitched the little cutter was cast free; but the high wind and tide hurried her away on the current like a cockleshell, despite the utmost exertions of the rowers.

It was a wild and picturesque scene; a grand but stormy sunset had just burned itself out in the west, and the dusk of night was slowly settling down. Buoys with nightlights were floated after the cutter, the men rowed desperately to hold their own against the sea, but all in vain. There was no help for it but to up anchor and go in chase of them. After a time we came upon them in the darkness, picked them up, and steamed about till daylight, when a boat was put off to fetch the lifeboat's crew on board. We remained idle several days, hoping that wind and tide would moderate sufficiently to let us lay the T-piece, but there being no signs of it we decided to go to a point nearer the coast where the current would be less powerful. We, therefore, "spliced on" to the Para end again, and proceeded with the laying. Our first message from Para was to the effect that we had been suddenly put into communication with London by the completion of the Brazilian Submarine cable from Lisbon to Pernambuco; and it was a fact that between our ship out at sea, somewhere off Cayenne, a complete metallic circuit connected us up to England. It was as if home had been suddenly brought near to us; and telegrams were sent off announcing the completion of the work so far.

After running twenty-five miles nearer to Cayenne, we anchored again, cut and buoyed the Para end, then coiled the T-piece by itself in a small boat ready for laying. The leg of the T-piece was then spliced to the cable on board, which was to be laid into Cayenne; one arm was spliced to the Para end on board the lifeboat, and the other arm, destined to be spliced to the Demerara end, was for the present sealed up to keep out the sea-water, and buoyed. Two ends of cable are spliced by unwinding the sheathing from them, paring off the insulator, and soldering the copper wires together. Fresh insulator is then applied to cover the soldered joint, and the sheathing is interwoven over all. After the insulator has been applied, the joint is tested electrically, to see if it be not defective.

(TO BE CONTINUED.)

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Jan. 5.		Business Done Week Ending Jan. 5. Highest.	Lowest.
Anglo-American Ordinary	59¼,	60¼	61¼	59¼
Do. "B"	88¼,	¼	90¼	88
Do. "A"	31¼,	¼	32¼	31
Brazilian	9¼,	10	10	9¼
Cuba	8¼,	9¼	9	8 15-16
Do. Ten per Cent. Pref.	16¼,	17	—	—
Direct Spanish	2¼,	3¼	—	—
Do. Ten per Cent. Preference	12¼,	¼	—	—
Direct United States	11 1-16,	3-16	11¼	10¼
Eastern	9 13-16,	15-16	9 15-16	9¼
Do. Six per Cent. Debenture	102,	106	103	103
Do. Five per Ct. do. 1899	102,	105	105¼	105
Do. Six p Ct. Pref	12¼,	13	12¼	12¼
Eastern Extension	10 3-16,	5-16	10¼	10¼
Do. Six per Ct. Deb	110,	113	—	—
German Union	10¼,	¼	10¼	10¼
Globe Telegraph & Trust	6 9-16,	11-16	6 11-16	6¼
Do. Six p Ct. Preference	12,	¼	12¼	12
Great Northern	10¾,	11	11¼	10¾
Indo-European	25¼,	26¼	26	26
Mediterranean Extension	2¾,	3¼	—	—
Do. Eight p Cent. Pref	10¾,	11¼	—	—
Reuter's	10¾,	11¼	10¾	10¾
Submarine	260,	265	264	264
West India and Panama	2,	¼	2¼	2
Do. Six per Cent. 1st Preference	6¾	7¼	7¼	7¼
Western and Brazilian	8¼,	¼	8 13-16	8¼
West. Union 7 p. Ct. 1st Mt.	120,	125	124	124
Do. Six per Ct. Sterg.	104,	107	106	106

TRAFFIC RECEIPTS FOR DECEMBER, 1880.

Companies.	Dec., 1880.	Dec., 1879.	Increse.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,300 estd.	3,317	—	1,017
Direct Spanish Telegraph Company	—	—	—	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	48,776	45,704	3,072	—
Eastern Extension Telegraph Company	28,010	26,025	1,985	—
Great Northern Telegraph Company	16,800	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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ABSTRACTS OF SPECIFICATIONS.

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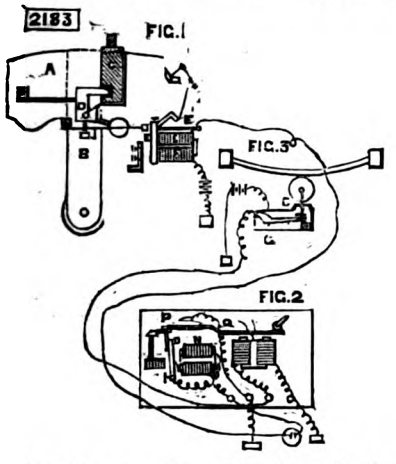
2183. IMPROVEMENTS IN RAILWAY SIGNALLING APPARATUS. *By Charles Ernesto Spagnoletti. Dated 28th May.* 6d.

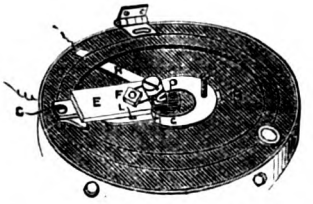
This invention has for its object improvements in controlling and working trains on railways by locking signals and interlocking them with the block telegraph system by electrical and mechanical means, and the trains in their course can be made to complete the system. The inventor attaches to the signal frame a small wheel with two slots in it, or a catch lock working in the lever lock, which catch can be duplicated to lock the lever also. Attached to this is a balance weight, and on the lever frame is a spring and stop piece acted on by movement of the lever for relocking it. A coloured disc indicator is attached to the frame to show when the lock is "on" or "off," and also a handle for unlocking the signal lock if required. By these arrangements the knuckle lock of the signal lever, or the lever itself, can be either kept locked or be released at the pleasure of the signalman at the station in advance. Electro-magnets are employed, and so arranged as to act upon a small lever bar, and in the wheel system one end of this drops into one of the slots of the wheel, and when in this position the lever cannot be moved to lower the signal. When the bar is out of the slot (which is affected by an electric current) the lever can be moved, the signal lowered, and again be restored to its position of "danger only," and is then again locked. The lever bar which locks and unlocks the wheel acts by a catch or a spring, and when acted upon by the current is held by a catch which is released by the movement of the lever. An electro magnet is placed in circuit with the line wire with a polarised or soft iron armature as required,



and when the current is sent to release the signal the line wire is broken down, and no second current can be sent to allow a following train to proceed until the previous one has arrived and reset the apparatus to complete the line wire, or until the lever allowing the train to enter the next section has been lowered and put to "danger" again. This apparatus can be worked either mechanically or electrically by the train or lever. If electrically a releasing relay is used with two sets of electro magnets, one to draw an anmature, which is caught with a catch, and the other to release the catch holding the armature. With one line wire only a polarised relay is used. A friction roller is fixed on a rod, to which a strong spring is attached to keep roller in required position, also a block of vulcanized india rubber to prevent the dropping of the roller if the spring should break; or two bars of metal are used on an incline, which bars are protected by a covering, and on the last vehicle a wire brush is placed, which passes over or between or under the metals, so that by the passing of a train contact is made by either apparatus and line wire joined up again. This can also be done by any of the patented treadles. In cases of slip coaches it is arranged so that on the slipping of one or more coaches the brush of the last vehicle of the train then proceeding is lowered to take the place of the one hitherto used on the slip coach. If from any cause it should be required arrangements are also made that it shall only be reset by the last vehicle on the train. To complete this system a "train describer" is used, so that the signalman or person working the signals may know the character of the approaching train, whether fast or slow, goods or passengers, &c. In the diagram Fig. 3 shows the carriage attachment pressing friction roller C, while Figs. 2 and 1 show the connections, the latter showing the locking gear. In considering the apparatus it is necessary to understand the action of the various armatures.

*234744. MICROPHONE.—(*Emile Berliner, Boston, Mass.*)—(*Filed March* 31, 1880.)—(*No model.*)—*Patented in France Jan.* 8, 1880; *in Belgium Jan.* 9, 1880; *and in Italy Feb.* 15, 1880.

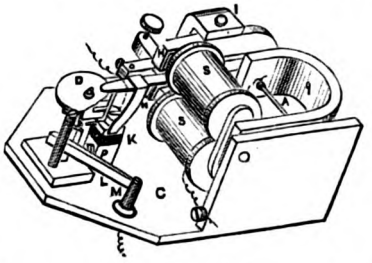
Claim.—1. A microphone or contact-telephone in which one electrode is held in position by being suspended from or attached to a permanent magnet by attraction, substantially as and for the purpose set forth. 2. In a microphone or contact-telephone, the combination of a vibrating surface, a damper consisting of an elastic arm provided with an adjusting screw, the extreme point of which bears against the said vibrating surface, and two electrodes in variable contact with one another, which are situated between said screw-point and the edge of said vibrating surface. 3. In a microphone or contact-telephone, the combination of a vibrating surface forming one electrode of an elec-



tric current, a pendulous weight forming the opposite electrode, and a device for changing the inclination of said pendulous weight, substantially as and for the purpose set forth. 4. In a microphone or contact-telephone, the combination of the diaphragm B, carbon block P, adjustable weight G, plate H, forming an armature-magnet, E, elastic plate L, and adjusting-screw M, substantially as and for the purpose set forth. 5. In a telephonic apparatus, a magnet forming an electric contact and electroplated on its face in contact, substantially as and for the purpose set forth.

*234773. SWITCH FOR TELEPHONE LINES. *Charles D. Haskins, New York, N.Y. Filed March* 15, 1880. (*Model.*)

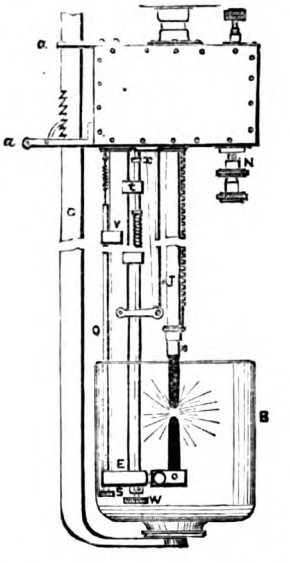
Claim.—1. In a series of telephones upon the same main circuit, connected with a central station, the combination, with each of the telephones, of a shunt or cut-out operated by a current over the main circuit, and a locking device for each of said shunts or cut-outs, independently operated for locking by a current in one direction over said main circuit, and for unlocking by a reversed current, whereby any given number of telephones may be placed in communication, and all the other telephones may be cut out of the circuit by an operator at the central station, except those at stations where the shunt or circuit is locked. 2. The combination, with the



telephone and signal at each station, of a telephone-shunt and shunt-lock operated by a series of pulsations of the same polarity, and a signal-shunt and shunt-lock operated independently of each other by means of reversed currents, whereby the operator at the central station may call any given station and place it in communication with any other without actuating the signals of any but these two stations, and then shunt out of circuit the call-bell, telephone, and break-key at the remaining stations. 3. The combination, with the vibratory tongue *o*, operated by reversals of the main-line current, of the unison-stop controlled by said vibratory tongue, and the call-bell shunt, operated also by said tongue and controlled by a current over the main line, substantially as described. 4. The combination, with the vibratory tongue *o*, operated by reversals of the current, of the unison devices controlled by said tongue, and the telephone-shunt and its operating devices controlled by a current over the main line, substantially as described. 5. The combination, with a single polarised magnet, of the vibratory-tongue armature, the unison devices, and call-bell shunt controlled by said tongue, and the telephone-shunt and the devices operated by said magnet for actuating said stop and telephone-shunt, substantially as described. 6. The combination, with the telephone switch-lever *l*, carrying the spring arm *g*, insulated therefrom, and the spring g^1 in electrical contact therewith, of the metal segment *m*, having its ends so arranged that when the switch-lever is in its normal position one of said ends will be in contact with spring-arm *g* and the telephone switched out of the main circuit, and when the said lever is swung outward the other end of said segment will be in contact with arm g^1, and the telephone switched into the main circuit, substantially as described.

*234835. ELECTRIC LAMP.—(*Hiram S. Maxim, Brooklyn, assignor, by mesne assignment, to the United States Electric Lighting Company, New York, N.Y.*)—(*Filed May* 4, 1880). (*No model.*)

Claim.—1. In an electric lamp a gravitating carrier for the upper carbon and a train of gearing controlling its descent, in combination with an electro-magnet and armature lever operating a detent engaging with said gearing, and a carrier for the lower carbon suspended from said lever, substantially as described. 2. In an electric lamp, an electro-magnet and mechanism for controlling the feeding of the upper carbon, located above the focus, in combination with a carrier for the lower carbon, movable vertically, and connected with the armature-lever of said electro-magnet, substantially as described. 3. In an electric lamp, an electro-magnet controlling the feeding mechanism, in combination with a dash-pot or controlling-chamber fixed to the armature or core of the electro-magnet and surrounding



its head, substantially as described. 4. In an electric lamp, the combination of a lower carbon carrier and a globe surrounding the focus, with their flat supports for said carrier and globe placed edge to edge upon the same side of the focus and in the same vertical plane with it, substantially as described. 5. The carbon-carrier E, in combination with the bar G, the link H, and flexible strap I, substantially as described. 6. The carbon-carrier E, in combination with the adjustible spring R, the spring V, rod T, and forked head W, substantially as described. 7. The side pieces *d* d^1, in combination with the screw *b*, pin *g*, and jaws *c*, substantially as described. 8. The combination of the globe B with the support C and the dog *c*, substantially as described.

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SLIP

West Indies.—The several West India cables are now all of them in working order.

Charing Cross.—This station of the South Eastern Railway is now lighted by means of the Brush system.

Personal.—Colonel R. Murray, Director-General of Telegraphs in India, has been granted three months' leave.

French Telegraphs.—The receipts for the past year from all sources for telegraph service amount to 27,008,000fr.—*L'Electricité*.

The Telephone in Spain.—Applications have been made to the municipalities of Seville and Cadiz for permission to establish a system of telephones in these places.

Greenock.—The Harbour Trust has invited the various electric light companies to give a display of their apparatus on the steamboat quay, with a view to a permanent use of one system.

Postal Telegraph Service.—Mr. Fawcett has, we understand, handed over to the Civil Service Commissioners the right exercised by previous postmasters-general to nominate candidates for the telegraph service.

The Atlantic Telegraph Companies.—The agreements between the Anglo-American Telegraph Company, the Direct United States Telegraph Company, and La Compagnie Française du Télégraphe de Paris à New York were considered on Friday, the 12th January.

The International Electrical Exhibition. — The *Standard's* Paris correspondent states that the German, Dutch, Swiss, and Italian Governments have already notified their adhesion, and the participation of England, the United States, Russia, and Austria is confidently anticipated.

Middlesbrough.—Complaints having been made as to the inadequacy of the Middlesbro' telegraph service, the secretary of the Chamber of Commerce has been directed to inquire into the matter, and to ascertain on what terms the telephone will be placed between private residences and offices.

The Telephone for Diving Operations.—*L'Electricité* states that M. Dohrn has introduced the use of the telephone in connection with his scientific explorations of the bed of the Bay of Naples. By this means the diver and the boatmen overhead are able to communicate with each other as quickly and intelligibly as could be desired.

Prices.—The prices of gutta percha, as quoted, are, for genuine 6d. to 3s. per lb.; for re-boiled 2d. to 1s. per lb. India rubber per lb.: for Para, fine, 2s. 11½d., Negrohead 1s. 11d., Central American 1s. 6d. to 2s. 2d., Assam and Pegu 10d. to 1s. 10d., other East Indian 1s. 5d. to 1s. 11d., Madagascar and Mozambique 1s. 6d. to 2s. 0¼d.

The Central Telegraph Office.—A largely-attended preliminary meeting of the clerks in the Central Telegraph Office was held at the Ship Tavern, Ivy-lane, on Tuesday evening, representing a staff of upwards of 1,200, at which it was unanimously resolved to hold a further meeting to-day to consider their present position and future prospects.

A Society of Electricians for Spain.—It is proposed to form an Association of Spanish Electricians, for the purpose of bringing together members of the profession in that country, who at present have no means of communicating with each other. The association is intended to possess a museum, library, and work-shops, so as to provide members with means of acquiring both a theoretical and practical knowledge of the science. In addition to professors of electricity and working electricians, students, and persons interested in the subject will be eligible as members.

Siemens Brothers and Company.—Objects: To take over the business of Messrs. Siemens Brothers, as telegraphic engineers, electricians, and contractors. Capital £100,000, in £100 shares. Signatories (with one share each):—E. W. Siemens, Berlin; C. W. Siemens, 12, Queen Anne's-gate, Westminster; C. H. Siemens, same address; T. C. L. Loeffler, same address; A. W. Siemens, Berlin; W. G. Siemens, Berlin; and A. Siemens, 12, Queen Anne's-gate, Westminster. Directors must hold shares to the nominal amount of £10,000. Mr. Loeffler is appointed managing director. Dec. 28.

Mr. Fawcett and Telegraph Pay.—The Postmaster-General, speaking at Manchester, on Tuesday evening, the 4th inst., alluded to the discontent existing among the Post-office telegraphists with regard to pay and promotion, and promised that their representations should receive his most careful consideration, and that if he found he required more facts he would ask some of the provincial *employés* to come and see him in London. In answer to an inquiry from one of the Irish members in Parliament last Tuesday evening, the Postmaster-General gave a similar assurance, stating that he would spare no pains to arrive at a just conclusion with regard to the alleged grievances.

The New Atlantic Cables.—The following paragraph in some shape or other has been going the round of the papers during the past fortnight. A Woolwich paper gives it thus:—"The chief topic of conversation in Woolwich this week has been the news that Messrs. Siemens Brothers have secured an order for the construction of a double line of cable between America and Europe. The length of cable to be manufactured is 9,000 miles, the largest order probably ever given in the history of ocean telegraphy. It is stated that the firm will find employment for 2,000 hands for 18 months." We have reason to believe that Mr. Jay Gould is now in London, and that the order for the two new cables has actually been given.

The United Telephone Company (Limited).—A meeting of this Company was held on the 13th inst. to consider a resolution to the effect that its management was unsatisfactory. A discussion of over four hours ensued, taken part in by the Right Hon. E. P. Bouverie, who moved the resolution; Viscount Anson, who seconded it; Mr. James Brand, who presided; Mr. J. S. Forbes, Mr. Hubbard, Mr. Gower, and other gentlemen, and ultimately, on the motion of Mr. E. H. Galsworthy, the following amendment was passed by 54 against 13:—"That this meeting, having heard the chairman's reply to various charges made by the minority of the Board, is of opinion that the shareholders should continue their confidence in the chairman and the majority." A full report of the proceedings will be published in our Special Edition this day.

St. Saviour's Guardians.—At the last meeting of the guardians a letter was received from the Brush Electric Light Corporation, stating that the company had contracted with the Commissioners of Sewers for the lighting by means of electricity, of Blackfriars Bridge, New Bridge-street, Ludgate-circus, Ludgate-hill, and other parts of the City, and were desirous of being allowed to lay down the necessary wires in a three-inch pipe underground, for the conveyance of the electricity from their works in Vine-street, Lambeth, *viâ* Stamford-street, to Blackfriars Bridge. The chairman thought the communication had better go to the Paving Com-

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mittee, and suggested whether the board could not try the experiment of the electric light at the standard at the top of the Southwark-street. Mr. Stafford would like to see the whole of Southwark-street lighted with the electric light. He moved the reference of the letter to the Paving Committee. Mr. Evans seconded the resolution, which was carried.

A New Process of Gas Lighting.—A new process of gas lighting has been introduced into the engineering and boiler making sheds of Messrs. Duncan, Stewart, and Co., London-road Ironworks, Glasgow. The inventor is Colonel A. P. Chamberlain. The gas, or atmospheric light as it is called, is produced by a process somewhat like ordinary coal gas. In the works a furnace has been erected within a small shed, and outside the shed is a gasometer. The furnace contains three retorts, and these are supplied with a combination of mineral oil, water, and air, which enter through a small pipe carried from the back to the front of the retort, and the gas finds an exit through a large pipe at the back of the retort. The vapour is conducted to the purifier, thence it is carried into the gas-holder, and then led through the old pipes in the works to the various machines and benches in the shop. The gas gives a whiter and more pure light than coal gas, or something between coal gas and the electric light. The odour is not offensive, and it is said to be freer from deleterious effects on pictures and paper than coal gas. The chief advantages claimed are, simplicity of application to public works, country churches, schools, and mansions. The cost is stated to be less than one-half that of coal gas.

British Electric Light Company's Experiments.—On Friday His Grace the Duke of Sutherland, the Marquis of Stafford, Sir Arnold Kemball, Colonel Green, Sir Eustace Pears, and others visited the offices of the British Electric Light Company, 41, Parliament-street, Westminster, to be present at a private exhibition of the new small lamps invented by Mr. St. George Lane Fox. These lamps are similar in principle to those being worked at by Mr. Edison. The lamps exhibited on Friday show that upwards of two years' labour by Mr. Lane Fox has resulted in, practically speaking, perfect success, as they gave a steady, pure white light. The incandescent carbon filaments, which were enclosed in glass bulbs from which the air had been exhausted, had already burned from 50 to 100 hours, and it is believed that in ordinary average use they will last for years. Fifty hours is, however, a sufficient length of time to make Mr. Lane Fox's system much cheaper than gas, to say nothing of its other advantages. The lamps are made of various powers; those shown on Friday were giving a light of about 10 candles each. Seven lights were burning on a very small Gramme machine capable of working 20, and it was shown that each lamp could be turned on and off as easily as gas, without affecting the others. Sir Henry Green, one of the directors of the British Electric Light Company, was also present, and the system was explained to the visitors by Mr. Lane Fox, the inventor, and Mr. Radcliffe Ward, the company's engineer.

Messrs. Matheson and Grant's Half-yearly Report.—This well-known firm, in their recent report, say:—"The electric light has during the past year been closely investigated, and the grounds upon which its merits can be judged are to a large extent laid bare. In London and elsewhere elaborate experiments have been made, not only in the lighting of streets and open spaces, but also of docks, railway stations, steel works, and factories. As a summary of the conclusions already arrived at, it may be said that, with the relative cost of gas and of fuel-power prevailing in England, more light can be produced by electricity than by gas for a given expenditure of money, but that for street lighting a greater absolute outlay is needed than with gas of the present illuminating power. On the other hand, the electric light has been so recently introduced that it would be premature and unfair to compare its cost with that of gas so many years established; and it is already evident that the improvements now being effected will render the comparison less favourable for gas. Not only have the details of the electric lamps been simplified, and the difficulties of subdivision reduced, but the regulation of the motors and the steadiness of the lighting have been rendered more certain. And while, where power for electric motors can only be obtained from coal fuel, the cost of electric lighting and coal gas may rest on a common basis, the comparison will be altered in places where gas coal is dear, and other fuel, such as wood or oil, or even water-power, is cheap. One most interesting field for future invention is the transmutation of fuel heat into electric energy more directly and cheaply than, as at present, through the medium of steam or gas engines."

Experiments in Electric Lighting at Alnwick Castle.—By the direction of the Duke of Northumberland, some interesting and successful experiments with Swan's electric lighting apparatus are at present being conducted at Alnwick Castle, the result of which there is little doubt will be the permanent adoption of this mode of lighting at the castle. The experiment is being made under the direction of Mr. Reavell, architect at the castle, and Mr. Ridley, electrical engineer, Newcastle, acting on behalf of Mr. Swan, the inventor of the electric lamps. The motive power is being temporarily supplied by one of Fowler's traction engines, which has been placed in the courtyard outside of the main entrance to the castle. It works a Gramme generator, which supplies the electric current to the lamps. These have been fitted up in the library, anteroom, and music room. In the library, which is a lofty and handsome room, three lamps have been suspended, each of which includes within a ground glass globe a set of three of Swan's carbon lights. There are thus nine lights in three triple groups for the illumination of the library, the same number in the music room, and one triple light lamp in the ante room making twenty one lights altogether, which are supplied by the current from a single Gramme machine. The lamps were experimentally lighted last Saturday evening, and again on Monday night, with an effect which has given the highest satisfaction to his grace and to all who have witnessed it. In the library the success is complete, and we may, indeed, unhesitatingly say magnificent. The three lamps completely lighted the apartment in a manner that had never before been accomplished by gas jets or candles, while the perfect purity, steadiness, and softness of the illumination pleased and delighted every gazer. The ante room was very efficiently lighted with the single lamp; whilst in the music room, the only defect arose from the lights having been experimentally placed in the lofty ceiling of the apartment. They will require to be lowered in order to produce a similarly successful effect to that obtained in the library. On the whole the experiment may already be pronounced to be most satisfactory.

Licensed Telephone Exchange.—In our issue for the 9th October last, when giving a brief notice of the Exhibition of Lighting and Heating Appliances, &c., then being held in Glasgow, we made mention of the telephone exchange which had been established in that city by Messrs. D. and G. Graham, a firm occupying a prominent position in the electrical department of the Exhibition. We now learn with

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much satisfaction that Messrs. Graham have since made very great progress with their telephone exchange system. They have established medical, legal, commercial, and stock-broker's telephonic exchanges at their extensive premises in Sandiehall-street, and they are at present opening premises in the very centre of the business portion of the city as a Manufacturers' Exchange, and partly also for the convenience of the subscribers to the other portions of their exchange system. Within the last few days the three leading theatres of the city have been embraced in the system, not the least important advantage of which is that they are put into speaking connection with the Central Fire Brigade Station. The extent to which Messrs. Graham's telephonic exchange system is being taken advantage of may be judged by the fact that as many as six connections have been already made for Messrs. G. and J. Burns, of the Cunard Steamship Company, and a similar number for an eminent colliery firm, while for another large business concern in the City there are something like twenty connections in course of being made. It will also afford some indication of the extent to which telephonic telegraphy is being carried on in Glasgow by Messrs. Graham if we mention that, in addition to some hundreds of instruments already fitted up and in use, they some time ago gave out an order for 800 telephones of the Gower-Bell type. That is certainly a very striking indication of the progress now being made in Glasgow. It is also worthy of remark that Messrs. Graham have just secured the right to the exclusive use of the Gower-Bell telephone over an area extending to thirty miles round Glasgow, an area which embraces many towns and districts of commercial and manufacturing importance. But perhaps the most important fact in connection with the enterprise in which Messrs. Graham are engaged is that the firm has been granted a license from the Postmaster-General, in response to an application which they made to the Post Office authorities prior to (not *after*) the decision given by the Judges of the Court of Exchequer in the Telephone case. We have not learned what the exact terms of the license are, nor are we certain that the formal document has yet been handed over to Messrs. Graham; but the very fact that they have been granted a license is quite sufficient to show how the leading officials at St. Martin's-le-Grand regard the immediate future of telephonic telegraphy. We may now confidently expect that licensed telephonic exchanges will be established in other parts of the kingdom, unless the Post Office people think that they can overtake all the work that may arise until the new system of speech-communication between persons at a distance shall have attained much more formidable proportions than are at present contemplated in some quarters. It is scarcely expected that in the meantime any more licensed exchanges will be allowed in Glasgow, and it is a step in advance to know that, by securing a legal position for themselves, Messrs. Graham have inspired much confidence in the minds of their exchange-subscribers, both actual and prospective.

Belgium.—In September last an International Congress of Commerce and Industry was held in Brussels, and in the Scientific Section papers were read on electrical subjects, such as "Telephonic Communication," "Electric Light," &c. A brief report of the Congress is given in Mr. Kennedy's report to Earl Granville. He says:—"M. Bede read an interesting report on telegraphic communication, explaining the principal points of the two telephones already known—viz., battery telephones, for which the Reiss and Gray apparatus are used, and the telephone without battery, of which Bell's system is the prototype. Two apparatus with batteries have, he said, been taken up—viz., Edison's and Blake's. M. Bede, without speaking more in favour of the one than the other, simply affirmed that numerous systems are in existence, and capable of meeting all the wants of the public. He went on to examine the question of telephonic communications in cities, and from one town to another. He considered it important that the connection between the central offices and telephonic lines should be perfected and examined, the advantages and disadvantages of above and under ground telephonic wires. He thought that the State should not monopolise telephonic communication, but should leave its working to private enterprise, and not fear its competing with the telegraph or Post Office. M. de Lochl Labye, an engineer, explained to the meeting a pantelephone of his own invention. In his opinion local telephones are, and must be, undertakings of public interest, or, in other words, each person, subscriber or not, should be able to use it. On this condition only could the State allow the highways to be used. He was strongly in favour of a concession being given to one company in each district, as the best means of promoting the interests of a service incapable of division. He quoted the examples of London and Paris, where, after numerous battles and years of competition, companies amalgamated; and, in conclusion, he suggested that each concession should be put up to auction. M. Bede expressed a contrary opinion to that of M. de Lochl Labye as to each concession being put up to auction; he thought it should be left entirely to private enterprise; he added that the Department of Public Works was antagonistic to the proposal, and, with every respect for the Telegraph Department, he still thought that this new enterprise would best succeed under private companies. M. Evrard considered that there should be but one company per district, so as to avoid disputes; but that a monopoly can only belong to Government. In answer to M. Bede, he would say that telegraphic connections exist already, and that there had been no complaints made against any of the offices so connected; he thought that the Government would manage matters far better than a private company. M. Bouguie remarked that in France the State alone has the right of fixing wires; and that this circumstance is a great drawback to telephone development. M. Bede thought that no comparison could be drawn between telegraphic and telephonic apparatus; therefore the staff of the State would not serve for the last-named undertaking. M. Desguin considered that only one branch should exist in each town unless the companies were amalgamated; otherwise the subscribers to one would be isolated from others, and the public would consequently be deprived of advantages. As regards the stimulus of competition, it would be replaced by the interest of companies to increase the number of their subscribers and to perfect their apparatus. He thought that the intervention of Government would be more simple than in postal and telegraphic matters, as the telephone requires no intermediary clerk, neither does it leave any trace. The telephone being made a public service, public powers should be brought to bear on the creation of branch communications either by direct action or by concessions; finally, he said that all countries would be covered with one vast system of telephones in the hands of Government, but meanwhile the States should not pretend to assimilate them to telegraphs. In conclusion, the following resolution was proposed and voted:—'The Congress, considering that telephonic communications are of general interest, desires that a law may be speedily voted on the granting of concessions.'"

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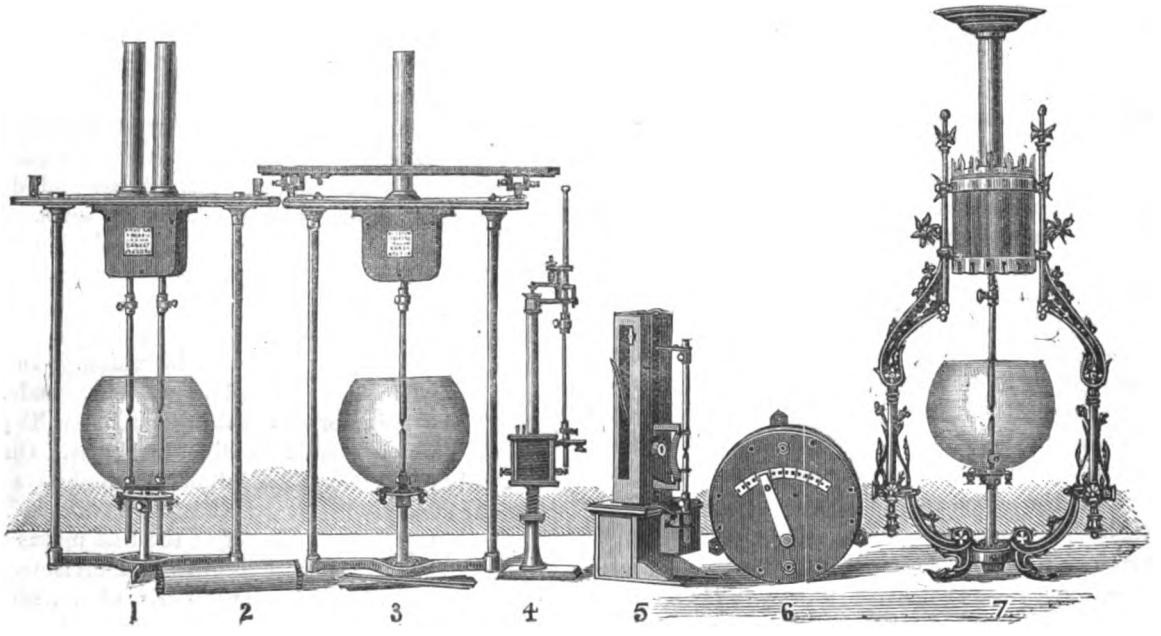
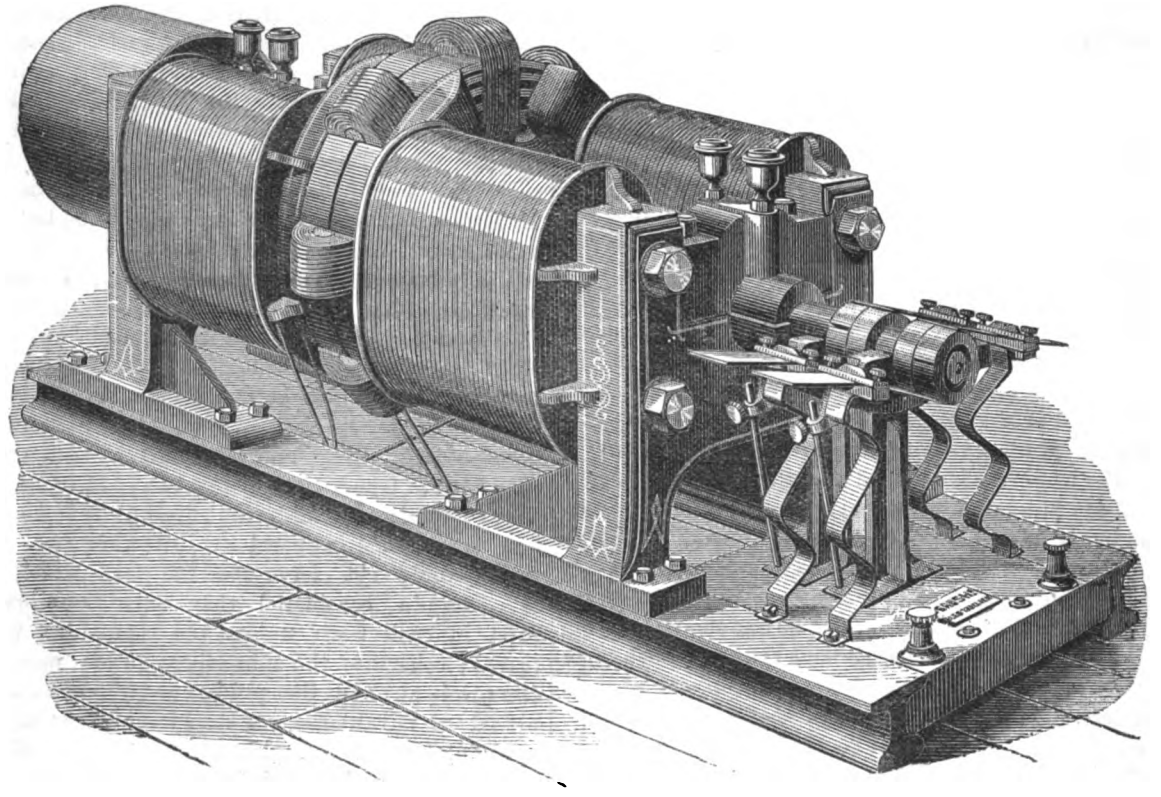
LIGHTING BROADWAY, NEW YORK, WITH THE BRUSH ELECTRIC LIGHT.





A few months ago it was announced that the Brush Electric Light Company, of New York, had been organised for the purpose of introducing the electric light into this city for lighting the streets, parks, and large buildings. That company has not been idle during the intervening time, but has located the first station and put down the first plant at 133 and 135, West Twenty-fifth-street. First, there is a Corliss engine in operation, built by Watts, Campbell, and Co. The foundation has been arranged for the reception of a pair of 18in. by 42in. engines, to be connected to the same shaft, only one of these engines being now in place. The engine now running is rated at 100 horse-power, but can be worked up to 125 horse-power. The fly-wheel is 16ft. in diameter, has a 32in. face, runs at a speed of eighty revolutions per minute, and weighs 25,000lb. The main belt is 71ft. long and 30in. wide. This belt makes a speed of a little upwards of 4,000ft. per minute. The boilers for furnishing steam to drive the engines are of the horizontal tubular style, the shells being 16ft. long and 5½ft. in diameter. The upper half of the shells are made of iron, while the lower half is of steel. Each boiler has ninety-two tubes 3in. in diameter, and they are set according to the Jarvis system, with special improvements by Charles A. Berton, the furnaces being arranged for burning coal dust, composed of about one part of bituminous coal to ten parts dust. The whole plant has been devised and constructed under the supervision of Mr. W. H. M'Grath, the engineer of the company. His object is to obtain power at the lowest possible cost, and the result will be watched with interest.

There will be two circuits connected with this station, which are to be supplied by five Brush dynamo-electric machines. One of these circuits is to be used exclusively for lighting parks and streets, while the other is for miscellaneous lighting, such as hotels, stores, and other buildings, it being found best not to confound the public with the private lighting.

A No. 7 Brush dynamo-electric machine is represented in one of the accompanying engravings. This machine is 68in. long, 30in. wide, 30in. high, and weighs 2,500lb. The pulley is 14in. in diameter, having a 9in. face, intended for a belt 8in. wide, which will drive the machine from 750 to 800 revolutions per

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minute. It is calculated to supply ten to eighteen lights, and requires 14 horse-power to drive it. A larger machine—a No. 8—is now being built, which is 8ft. long, and of the same style as No. 7. When finished, it is intended to run forty lights, requiring an expenditure of from 30 to 35 horse-power. The power here mentioned is calculated to run these machines to their full capacity, causing each lamp to furnish a light equal to that of 2,000 candles. The territory controlled by the company extends from Fourteenth-street, Union-square, to Thirty-fourth-street, and from Third Avenue to Eighth Avenue. The first practical electric lighting of streets in the city is upon Broadway, extending from Fourteenth-street to Thirty-fourth-street. Within these limits there are twenty-two lamps, one upon each block. The lamps are mounted upon iron posts of a neat and ornamental design, and 25 feet high, each lamp giving, as stated, a light of 2,000 candle-power.

The construction of the lamps will be better understood by referring to the engraving, in which Fig. 1 represents a No. 3, or double lamp. This lamp is fitted with two carbon rods, arranged so that when one set of the carbons is consumed, the second set is switched into the circuit, burning until they are consumed. This is done without any interruption whatever to the light. The lamp will burn from fourteen to sixteen hours without attention. A bundle of carbons is represented by Fig. 2, ready for transportation; while Fig. 3 shows a No. 2, or single lamp, similar in construction to Fig. 1, but having only one set of carbons. This lamp burns from seven to eight hours without attention. The lamps are all very simple in their construction, the mechanism insuring safety of management and regularity of operation. The double magnet circuit conveys the currents in opposite directions, by means of which any number of lamps may be operated in a single circuit without any irregularity of action. The short circulating safety attachment, by which any lamp offering an abnormally great resistance in consequence of the final consumption of its carbons, or other cause, will, without any change of strength in the main current, automatically short circuit the said lamp and thus preserve the general circuit. A multiple set of carbons, burning successively without the intervention of any switching or other special mechanism, secures the maintenance of the light for any desirable length of time without requiring attention or adjustment by the attendant other than placing the carbons. These lamps contain no clockwork or similar mechanism of any kind. The movement of the upper carbon actuated by gravity is controlled by a simple annular clamp which surrounds the rod carrying the carbon. When the lamp is in operation one side of this clamp is lifted by magnetic action, which causes it to grasp and raise the rod, and this separates the carbons. As the carbons burn away, the magnetic action diminishes, and the clamp and rod move downward, maintaining only a proper separation of the carbons. But when the tilted annular clamp finally touches the supporting floor from which it started, any further downward movement will at once release the rod, and allow it to slide through the clamp until the latter is again brought into action by the increased magnetism due to the shortened arc between the carbons. In continued operation the normal position of the clamp is in contact with its lower support; the office of the controlling magnet being to regulate the sliding of the rod through it. If, however, the rod slides too far, it will instantly and automatically be raised again, as at first, and the carbon points thus maintained in proper relation to each other.

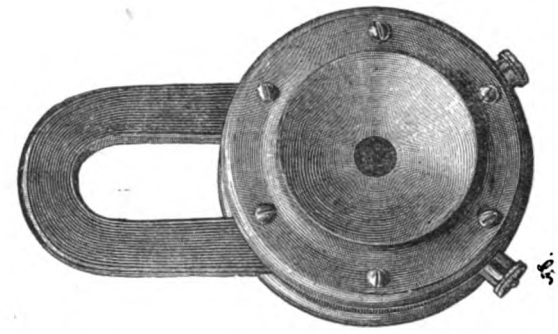
A focussing lamp, intended for projections in magic lanterns, or other similar apparatus, is shown in Fig. 4 of the engraving; and Fig. 5 represents a lamp intended for application to the reflectors of locomotive head lights, or for steamers. An ornamental lamp is shown in Fig. 7, adapted to use in hotels, stores, and other places where a showy lamp is needed. This lamp can be made either single or double, as desired. A regulating switch or dial attachment is shown in Fig. 6. It is intended for use in connection with the largest machines, and is so arranged that any number of lights—from one up to the full number—may be burned without varying the speed of the machine.

This first introduction of the Brush electric light into the metropolis for street lighting is only repeating here what has been done in other cities on this Continent. The longest circuit that we have known for electric lighting is in Montreal, O., where one of the Brush machines works a circuit of 14,000ft., or nearly two and three-quarter miles in length. The plant is on the wharves, and the lights illuminate the harbour, so that vessels can change their positions; also load and unload their cargoes as well at night as in the daytime. The invention is an entire success in this instance. In the Grand Pacific Hotel, Chicago, 570 gas jets have been replaced by seventeen electric lights, which, according to the statement of the proprietors, effects a saving of 300 dols. per month. This is only one instance, as an example of what is being done in the principal cities of the country.—*American Machinist.*

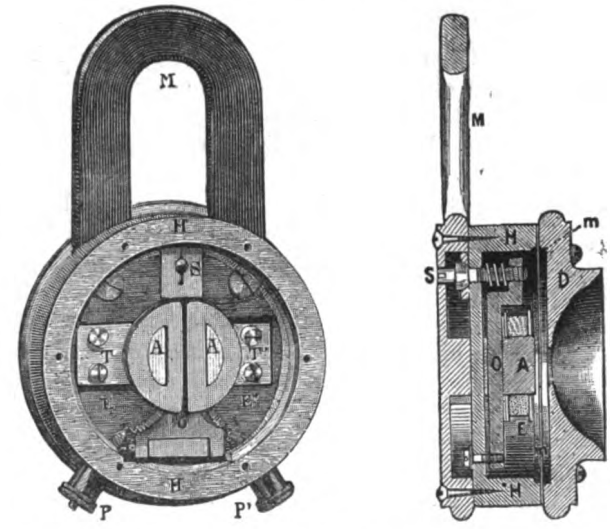
IMPROVEMENTS IN TELEPHONES.

BY W. E. FEIN.

In these telephones the cores of the magnets do not consist as usual of a bar of soft iron, but of a large number of iron wires, or plates insulated the one from the other. By this arrangement the electro-magnets change their magnetism much quicker under the vibrations of the diaphragm, thus increasing the effect of induction; further, the form of the cores differs from that usually adopted; owing to the section being segmentary a general central attraction of the diaphragm is the result, which exercises a great influence on the purity of the sounds. The segmentary armatures are surrounded by semi-circular coils; by adopting this method the space is fully utilised, the coils are wound with the greatest possible length of wire, so that these telephones will act over a long distance and through a large resistance. The improved telephones do not need any particular alarum; a little



reed tube is sufficient to produce an easily audible signal at the receiving station. The engraving (Fig. 1) gives the outer view of the telephone exactly one third the ordinary size; Fig. 2 shows the internal arrangements, the mouthpiece and the diaphragm being taken off; Fig. 3 the transverse section. The poles of the steel horseshoe magnet M are provided with the armatures T T′ which project from the sound box, so that the curve can be employed as a handle; moreover, the size of magnet that can thus be obtained increases considerably the magnetic force, which has a favourable influence on the efficacy of the instrument. The cores A A′ are formed like a segment of a circle; the centre of the segment is on the same line as the centre of the diaphragm. By this construction the attraction



and the vibrations of the diaphragm are rendered uniform, the tones of the voice being clearly transmitted. The distance of the electro-magnet from the diaphragm is regulated by a special arrangement. Between the bars of the steel magnet is placed the lever O; one of its ends is adjusted so as to move between two screw points, the other end is held by the screw S, by turning which the adjustment is made. A strong spiral spring prevents any getting out of place. The head of the screw is on the outside of the box, and can be turned by a screw driver. The two electro-magnets A A′ are fixed to the lever O, so that they follow its movements, sliding between the armatures T T′. The ends of the wires are connected to the terminals P P′ which receive the line wires.

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THE ELECTRICIAN.

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ELECTRIC LIGHTING ENTERPRISE.

That part of our retrospective summary which related to the progress of electric lighting during the past year proved not only that its usefulness was being more widely recognised but also that the new light was rapidly becoming popular.

Considering the many defects under which it still labours, its growing popularity is a highly encouraging sign for those who are interested in the future of electric lighting enterprise. Amongst these defects we may candidly admit that the theatrical, not to say unearthly, appearance of the light is one which had to be taken account of in reckoning with public prejudice. The displacement of oil by gas had no such difficulty to overcome; the inferiority of the old light was at once apparent. This is not the case with gas and electricity, at all events the public have a lingering attachment for the warmer light of the two, and it is only by burning them side by side that the preference is gradually being shifted. Gas light looks simply ridiculous in the presence of its modern rival. The public were not slow to realise this fact, and familiarity has gone a great way towards dispelling any remaining prejudice against the colder light. Another defect is its unsteadiness and uncertainty. Very much has been done to remedy this; but we have always held it to be the best policy to call attention to defects of this kind in order that they may be promptly remedied. Inventors may make light of them, but—without meaning any pun—we are sure that the public will not. Unsteadiness of gas lights is of no great consequence—one light always compensates for another. But where the illumination is derived from a comparatively insignificant number of points, unsteadiness of any one of them means all the difference between light and absolute dimness. Nowhere is the positive comfort and blessing of the electric light so immediately felt as in one of the underground railway stations. But a sense of disappointment and foreboding comes over one when our pleasurable study of the advertisement boards is momentarily interrupted by a collapse of the light. This is what happens more or less wherever we go. Our eyes have got accustomed to flickering lights, and we all have to endure them in our homes; but those vast undulations of light—swelling upwards and then sinking to depths of varying profundity—are what the public eye does not adapt itself to without murmuring; and again we say that the continued extension of this mode of lighting, notwithstanding its manifest imperfections, speaks well for its more perfect future.

That its future will be more perfect we have no manner of doubt; and we believe that it will be hastened rather than retarded by a frank recognition of shortcomings wherever they are apparent.

Two or three facts in our last week's summary struck us as significant, and not altogether what we should have liked. First there was still an absence of the light in what may properly be called small areas. With some few notable exceptions, and these not strictly of the kind we desiderate, railway stations, public works, huge docks, gigantic edifices, and main thoroughfares monopolise the present application of the system. We have not the same handy means of judging its adaptability for interiors; but inferentially it would seem that the verdict is not generally favourable as regards the systems before the public. The enthusiastic reception, however, of the Swan lamp points to at least as much progress in interior lighting during 1881 as there has been in exterior lighting in 1880. Then there is the notable fact that some of the most prominent systems of outdoor lighting are just where they were twelvemonths ago—at all events in respect to efficiency. Others have improved, but chiefly in the detail of mechanism, while one or two have increased their burning capacity by simply enlarging the carbons. Of marked advance in the direction of electrical improvement there is hardly any practical evidence. It is well known that improvement in that direction is going on, but the fact we are now commenting upon is the seeming absence of electrical progress among the companies now competing for public favour. Mr. Swan's lamp is an illustration of our meaning. The inventor is running alone. Had the same amount of ingenuity and attention been bestowed upon any of the several systems actually in operation as Mr. Swan has devoted to his own we cannot help thinking they would have been the better for it. The faults already adverted to, as well as others that need not be named, are for the most part remediable, and had it not been for the tendency so common in public companies not only to run exclusively the pet of their adoption but to run it as if it were a born perfection the introduction of electric lighting would have been more generally welcomed even than it has been.

The moral of what we have just been saying is that electric lighting companies should never be without their professional experts. It is seldom wise to stake all your money on one horse unless you are sure of his training. Even a middling animal will repay the investment if all his good points are properly and opportunely developed; and applying these sensible, though sporting, maxims to the subject under

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consideration, a good motor or a good lamp is pretty sure to be beaten out of the market unless electrical knowledge is constantly brought to bear upon it. We say electrical knowledge, because we are distinctly of opinion that all permanent and valuable improvement will finally be electrical. Mechanism, where it seems indispensable, should certainly be of the best; but the aim of the electrician would obviously be to dispense with mechanism wherever conceivably it can be dispensed with. Moreover, the constant investigations of a professional electrician on the spot would insure the possession of every practical device, or promising suggestion that experiment might reveal. In one respect Mr. Edison's has been the right course; but it had this fatal defect,—he had committed himself irretrievably to the solving of one problem in one particular way. Besides this, judged by the English standard, Mr. Edison is not a scientific expert, although he is one of the most ingenious of men. In England all eyes are not turned to one quarter for their enlightenment, and we do not suppose they ever will be; but it is not a quite satisfactory state of things that electric lighting should be left to the mere push and energy of the respective agents. Competition to gain the lasting goodwill of the public should be of another kind—the emulation of experienced electricians to devise a light that shall be at once reliable convenient, agreeable, and reasonably cheap.

Of the several openings for this form of competition none is more promising than that for indoor illumination. Even the question of cost in this relation need not at first give much concern, for a good incandescent light would be welcome at almost any price to the class of customers who would first have to be catered for by an incandescent lighting company. Its further extension to more popular uses—house to house illumination—would only be a work of time, if the promoters were electrically well served in the manner we have indicated. The age of gas has already passed its maturity; it has probably many years yet to run, but before the close of 1881 we expect to be able to foretell more confidently its certain, if not rapid, decline.

CORRESPONDENCE.

ELECTRIC LIGHTING.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The letter signed "T" in your issue of the 1st inst. may, I doubt not, be taken in a sense as official, seeing that the writer announces himself as "Mr. Crompton's manager in Glasgow."

However, he seems not to deny the impeachment contained in my former letter, but excuses himself by saying that these lamps were some of the earliest made. I have no wish to call in question the efforts made by Mr. Crompton, or the results so far obtained by him in electric lighting.

What I did, or attempted to do, was to call in question what I conceived to be an assumption that his system was superior to the Brush, and to this he has really furnished no reply, but an excuse.

The illustration given in his letter does not show very much—simply this, that the authorities at St. Enoch station had more confidence in the electric light than the authorities at Liverpool-street station, but at the latter they have not to my knowledge required to call in the aid of gas, though ready for use.

Can it be proved by Mr. Crompton or his manager that the Brush light is a failure in England? If so I must remark that it is due to English management, as this system is quite successful in America—in fact, it is the most perfect voltaic arc light I have yet witnessed, and, therefore, my grounds for saying that the latter system is more practicable than the Crompton are not unfounded.—Yours, &c., CHARLES LEVER.

Bowden, Cheshire, Jan. 6, 1881.

LESSONS FOR LEARNERS.

(CONTINUED FROM PAGE 81.)

If I ask a carpenter what is the length of a board, he tells me so many "*feet*," if I ask the surveyor the length of the side of a field, he tells me so many "*chains*," if I ask the grocer the weight of a piece of cheese, he tells me in "*pounds*," the milkman measures by "*pints*," and so on, every trade seeming to have its own particular *unit* of measurement. You will easily understand how important it is that we should all agee to express a "length" or a "weight" in terms of the same unit. If we were each to suit his own fancy there would be an end to comparison. The "foot," the "pound," and the "second" are the common English units of length, weight, and time. Electricians have found the necessity of a common system of units for their special work, so that, for example, when measuring the electric resistance of any substance they are able to state the resistance as so many of the "units of resistance." The name of the unit electricians have agreed to adopt is the "*ohm*."

$$1000000 \text{ ohms} = 1 \text{ megohm.}$$
$$\frac{1}{1000000} \text{ ohm} = 1 \text{ microhm.}$$

I must ask you to recall to mind how we have seen that material, sectional area, length, &c., have influence upon resistance. It will help you to understand what the resistance of an "ohm" is if you look carefully at these wires. I have here a coil of the ordinary telegraph wire. It is galvanised iron wire, No. 8 Birmingham wire gauge.

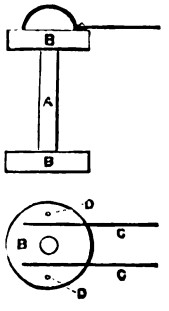
Now, 1 ohm of this wire, No. 8, B. W. G., measures about
1 ohm copper wire, No. 16 B. W. G., measures about 200 feet.
1 foot copper wire 3·117 mils.* diameter = 1 ohm.

You are all aware that most metals are more or less affected by changes in temperature. If the carpenter's rule varied much in length with changes of temperature it would be necessary to make the rule of some substance that undergoes little change in variations of temperature. The standards of resistance that are made for electricians to use are, therefore, made of platinum-silver or German silver—alloys that are little affected by such changes.

Here is some platinum-silver wire, such as is used by Messrs. Clark and Muirhead in making the standard resistances:—

Resistance in ohms.	Diameter in mils.	Length in metres.	Weight in dwts.
1	30	1·484	$4\frac{1}{2}$
10	15	3·707	$2\frac{3}{4}$
100	6	5·	$\frac{5}{8}$
10000	3	148·3	4 5grs.

The standard resistances that are used are generally made in the form of coils.



A is a hollow brass tube, upon the ends of which are fastened ebonite discs, B B. The upper disc B, besides the perforation corresponding to that of the tube A, has two smaller holes, D D, through which the ends of the wire are brought to be firmly soldered to the wire C C. The wires C C are used to connect one resistance coil to another. The tube A is covered with paper which, when dry, has been dipped in paraffin, and on it the wire for the standard resistance is wound. The workman takes a length of silk-covered wire as nearly as possible equal to the resistance required, sees that the silk covering is dry, then dips the covered wire into paraffin, puts the two ends of the wire together, and winds double upon the tube. The reason for the double winding we shall know hereafter. These precautions are necessary, as, in the first place, the brass tube is a conductor, and if by any accident the naked wire

* 1 mil. = $\frac{1}{1000}$ of an inch.

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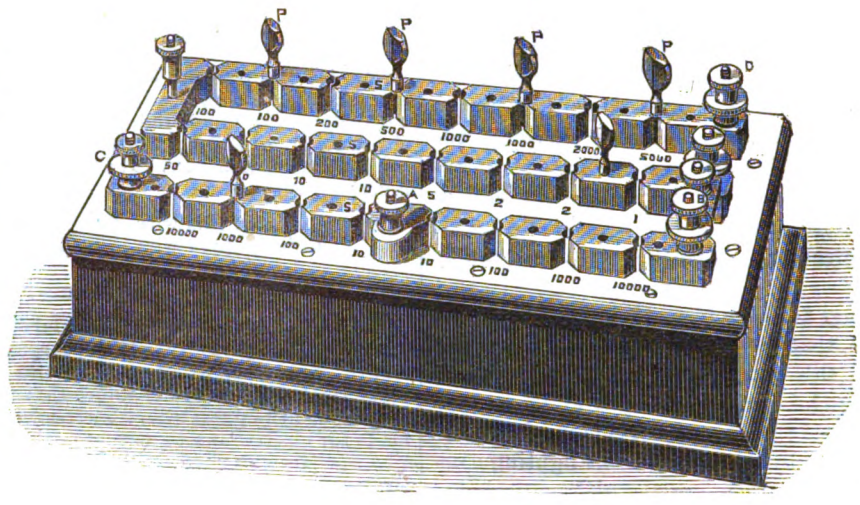
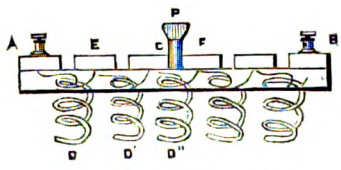
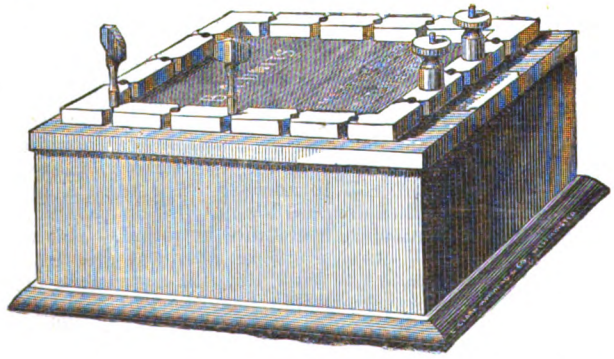
touched the brass at two points the resistance indicated by the coil would not be that of the whole length of wire, but only of a portion. So again, if two points of the uncovered wire touched, the electric current would not pass through the whole length of wire, but only a part, and the resistance of a part is not the same as the resistance of the whole. Silk and paraffin are insulators; the latter, however, is used more as a preservative against damp than anything. If the silk insulator were wet in any place, the action would be almost the same as touching the wires, and if the silk is damp before being dipped into the paraffin, it is impossible to get the good insulation required. Large sizes of wire are used for low resistances, and small sizes for high resistances, because a strong current passing through a short length of wire of small diameter would heat it considerably, perhaps even to fusion. Sir W. Thomson has said that no length of wire shorter than 1 metre should be used in a coil. These coils, then, are made of various resistances, and arranged so that a number of coils are placed conveniently for use. Generally they are arranged in a box so that the coils can be used to form the *known* resistances in *three* of the arms of a "Wheatstone bridge," the unknown resistance forming the other arm of the bridge, and then, as we have seen, it is easy to find the unknown resistance when three resistances are known. Here is a box of resistance coils so arranged. The top of the box is made of a slab of ebonite, upon which the brass pieces S S S S are screwed. You will notice the pieces of brass do not quite touch, but at each end of a disc is a semicircular hole. These brass plugs P P P P, with ebonite tops, fix into the holes and make contact between the flat strips of brass. Each separate strip of brass is connected with the ends of two distinct coils.





Here is a row of coils. If a current enters at A it passes through coil D to E through coil D′ to C, but if the brass strips C and F are connected by a metal plug, P, the current will not pass through D″ from C to F, but pass directly through the plug, and, so to speak, miss out coil D″. If, then, we want to use a certain resistance, we take out a particular plug or plugs, otherwise they are left to make contact between the metal strips.



Here is another box not so arranged, but simply giving a series of different resistance coils to be used as occasion requires.

I may just give a word or two of advice about using these resistance boxes. Keep the plugs, plug holes, and brass strips clean, dry, and free from dust. Touch the metal part of the plug as little as possible with the fingers. Have a little box lined with cloth or velvet to put the plugs in as you pull them from the

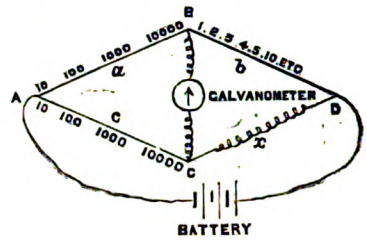


FIG. *a*.

holes. Be sure that each plug in use is firmly inserted. Previous to making contact for the current to pass, give a gentle screwy push to each plug, and take heed that the plugs are in the right places. Resistance boxes are not made to sit upon or to play football with, or to use as hammers. Much more might be said about them, but I must not forget that these are introductory lessons, and that after imbibing a certain amount of knowledge here you will, with some benefit to yourselves, read the many books upon these subjects.

You see the binding screws A B C, and D. The arms of the bridge are A B, A C, B D and the *unknown* resistance between C D. The resistance coils in the arms A B, A C, respectively, are 10, 100, 1000 and 10000 ohms. The galvanometer is connected between B C, the battery between A D. The diagram (Fig. *a*) will perhaps help to explain the arrangement:—The total resistance that I can get in the arm B D is 10000 ohms, so that whilst I keep the resistances in the arms A B, A C equal, I cannot measure a higher unknown resistance than 10000 ohms. We found, p. 80, the formula for finding the unknown resistance, viz.:—

$$a\,d = c\,b.$$

Instead of d I now use x, because the latter is almost always used to represent an unknown quantity. Hence we write

$$a\,x = c\,b$$

$$x = \frac{c\,b}{a},$$

whence, if $a = c$, then $x = b$; and, as in this case, I cannot make b more than 10,000 units, x cannot be measured if over 10,000 units.

Suppose, however, I make the resistance of A B = 10, while I keep the resistance in A C = 10,000, then, if I use the 10,000 units resistance in B D, I can measure

$$x = \frac{10000 \times 10000}{10} = 10{,}000{,}000.$$

I can obtain even a higher ratio for $\frac{c}{a}$ than $\frac{10000}{10}$. I may make it

$$\frac{10000 + 1000 + 100 + 10}{10} = \frac{11110}{10} \text{ or } \frac{1111}{1},$$

by which I can measure to

$$x = \frac{11110}{10} \times 10000 = 11{,}110{,}000.$$

Similarly, by inverting the ratios of the resistances, I can measure fractional parts of an ohm. Suppose $c = 10$, $b = 5$, $a = 100$ ohms, then

$$x = \frac{10}{100} \times 5 = \frac{1}{20},$$

and so on.

(TO BE CONTINUED.)

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NEW ELECTRIC MOTOR.*

BY WILLIAM WOODNUTT GRISCOM.

(CONTINUED FROM PAGE 93.)

By way of illustration, the application of human energy to the sewing machine is not only a false economy, but has proved the cause of many new and painful diseases in female operators, which embitter their lives and affect the physique of their offspring. If any motor can be substituted for human emergy in this field, there can be no greater or more convincing consideration offered to invite attention to it.

The sewing machine is in almost every house, and the seeds of these diseases are spread in every class of society. The remedy, as before mentioned, is a household motor, and it was natural to suggest a small steam engine for this purpose; but steam is unsuited to this end, because—

1st. It requires time and trouble to start it to work, and a busy housekeeper, who may only need, perhaps, to do five minutes of sewing, has no time to waste.

2nd. It is always liable to explode, or to burn out the boiler, or get various portions of its complex mechanism out of order, so as to require an experienced engine driver to repair it.

3rd. It emits an offensive odour of burnt or boiling oil, and vitiates the atmosphere with the products of combustion.

4th. It is really much more expensive than those steam engines from which our calculations were made. If gas is consumed for a household engine the fuel amounts to from twelve to twenty-five feet of gas per hour, costing for a motor giving one thirty-third of a horse-power as much as the fuel of a six or twelve horse-power steam engine.

This last consideration would not weigh with the actual sufferers of the acute forms of disease, but the other objections are serious, and apply to all heat-motors, such as gas, steam, and caloric engines.

Other motors are before the public—the various hydraulic motors which require the special introduction of water-pipe and waste-pipe, and entail yearly visits from those friends of humanity, the plumber and the tax-collector. Then there is the spring motor, which you wind up every quarter of an hour or so, expending, of course, much more power in the winding than you get out of it in work, and which has an unhappy habit of bursting its bonds occasionally, and venting its store of energy where it is least needed. Then there is the curious chair motor, whose mechanism is connected with the seat of the chair, and by various levers, cogs, cams and clutch to the sewing machine. The seat of the chair gradually sinks about three inches beneath the weight of the operator, driving the sewing machine the meanwhile. The operator then rises, the spring lifts the seat, and the performance is renewed. A rapid speed can be attained by rising and sinking forty times per minute.

It is now fair to examine the theoretical and practical objections to electric motors, used with batteries. They may be divided into two classes—those which utilise the attraction only of an armature to an electro-magnet like the motor which drives the clock in the institute library upstairs, and those which utilise the attraction and repulsion of two or more electro-magnets.

The former act by intermittent attraction only, and are wasteful of electric energy, because the residual magnetism, during the interruption of the current, retards the passage of the armature away from the pole which had just attracted it.

Those of the latter type, however, convert a portion of the retarding influence of the residual magnetism into a useful force; in fact, all dynamo-electric generators when used as motors convert all magnetic resistance to motion into a counter electromotive force. At first glance it seems strange to consider a counter force as an economy, but in point of fact it retards the consumption of zinc in the battery and tends to depolarise the negative plate. It has been usual to regard this counter electromotive force as increased resistance, but a simple experiment will show the error of this view, and will at the same time demonstrate that economical motors must also be efficient dynamo-electric machines in order to recover this force, which would otherwise be lost. A small motor of the type before you was held motionless while a sufficiently powerful current—let us say of four vebers per second—traversed its coils. A tangent galvanometer was in circuit, whose deflection was carefully observed. Then, without changing the connections, the motor was allowed to run at full speed, when the galvanometer indicated about one-fourth of the original amount of current. The electromotive force of the battery was practically constant, and, therefore, according to the formula

$$\frac{\text{Electromotive force}}{\text{Resistance}} = \text{Current}$$

the galvanometer should have indicated the same current as at first, unless the resistance had been changed or a counter electromotive force produced. The speed of rotation was then diminished by a brake, and the needle immediately indicated a greater current. This is in direct conformity with the well-known law that the electromotive force of a dynamo-electri machine varies with the speed of rotation, whereas the resistance of a coil is not affected by mere motion.

A still more striking proof that the "back-pull" of residual magnetism may be converted usefully into electricity is exemplified in a motor constructed more than a year ago by the writer on the same principle as this one, save that the field-coils are free and not connected with the battery. The current of the battery is sent through the armature, which revolves with considerable rapidity. If the free ends of the field-coils are now connected the speed is immensely increased, and if the ends are separated a spark appears. Of course there is some loss. The entire amount of energy wasted in retarding the armature is not recovered, but nevertheless the increase of power due to this one economy is very astonishing.

The little motor exhibited this evening is also an efficient dynamo-electric machine. The most essential advantage which it possesses over the older forms is in the field magnets. Their peculiar shape is such that all the magnetic lines of force, including those nearest the neutral line, are brought into the best possible position for effecting the revolution of the magnetic armature. I believe that the distinguished inventor, Mr. Ladd, of England, claims, in an article which appeared lately in one of the journals, to have discovered the great advantage possessed by the lines of force of a nearly circular magnet over those in the usual horse shoe form magnet, but he does not appear to have attempted to utilise the lines of force which fill the interior of a curved magnet from the neutral to the polar points. If a bar of soft iron is pivoted at one end, so as to move in a horizontal plane, and a semi-circular magnet is placed concentrically with the circle which the bar can describe, it is found that a given force is exerted upon the bar, at a much greater distance from the poles, when the latter is within the semicircle than when it is without. I believe that no field magnets of this principle have ever before been made, and herein is the secret of the power of this little motor, which weighs about 2½ pounds, and which compares favourably with those of the old forms of fifteen times its weight. The inductive actions which are produced in these field magnets at each revolution of the armature are exceedingly complex, and I shall not trespass further on your attention, except to give a brief *resumé* of the practical defects of electric motors, and how they have been overcome in the investigation of which this motor is the result.

The great bugbear of those who have used electric motors has been the battery. It gave forth offensive and poisonous vapours; it required almost continual attention; it used concentrated acids, and it became rapidly exhausted whether it was used or not.

All these objections are now done away with. The present battery is enclosed in a strong water-proof box, does not use concentrated acids, gives out no odour, does not exhaust itself, requires renewing only after the fluid is used up by actual work, will last months or years if left to itself and be in as good order as at the beginning. It requires absolutely no attention until the reservoir is exhausted by actual work, and it is ready without a moment's warning at all times and seasons. It is calculated that the battery will suffice for the sewing of a small family for one year. A professional seamstress would exhaust it more rapidly, but always in proportion to the exact amount of work done. It will be shown that this form of battery places the speed of the motor under complete control without effort on the part of the operator.

The attention of mechanicians is invited to the fact that this form of motor, owing to the force being applied equally to both sides of the shaft at once, entails absolutely no wear on the journals except from the weight of the armature, which is very light, and the tension of the belt, which transmits the power. The length of bearing is four times the diameter of the shaft, and the design of the motor is such that no amount of wear can cause the poles of the armature and magnets to come in contact, which was a frequent source of annoyance in other motors. The motor is attached to the machine, and is of such dimensions as to be readily concealed from view if preferred. There is also a device for readily changing the tension of the belt.

The power of the motor is sufficient to sew leather, or as much tightly woven linen as can be put under the presser. With a sufficient battery power it can give any speed varying from twenty to two thousand stiches per minute in instant obedience to the will of the operator. A safe working speed for constant use is eight hundred to one thousand stitches per minute, which is considerably faster than is now attained by professional sewing women, while others seldom sew more than three hundred to four hundred stiches per minute.

* Paper read before the Franklin Institute Nov. 17th, 1880.

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CABLE-LAYING IN GUIANA.

BY J. MUNRO, C.E.

(CONTINUED FROM PAGE 94.)

It is a curious sight to see a joint tested at night on the deck of a cable steamer, and one which would have greatly puzzled Captain Kidd or even any highly respectable navigator of the good old times before electricity was cultivated—the skilful, keen-eyed electrician supporting his delicate electrometer between his hands, and scrutinising the scale for an observation, forming the central figure of a ring of grimy cable hands holding the lanterns, whose glare falls on their blear-eyed, sleepy faces, and on the puzzled expression of some simple tar peering over their shoulders to get a sight of the mysteries of a telegraph ship.

On the 1st of July we anchored off Cayenne, in the soft, muddy bottom, where the ship lay as if in dock. The coast is low and flat, except here and there, where some isolated mountain, densely furred with dark green forests, loomed against the sky like a crouching jaguar. There was the same peculiar gloomy, thunderous sunshine, and savage jungle here as on the Amazon. The town of Cayenne, the capital of French Guiana, is situated at the mouth of a creek of that name, and on the side of a rocky hill or citadel on which has been built a lighthouse and a fort—Fort Ceperou. From the ship we could see the red-tiled roofs of its barracks and prisons showing out under the feathery crests of many palmistes, or cabbage palms. Like Para, Cayenne too has seen better days. Fifty years ago it was a flourishing tropical colony, with a prosperous city and extensive plantations of spice and sugar scattered over the country. The French colonists brought with them their characteristic gaiety and adaptability, and set up a slave-owning aristocracy as in the palmy days of the West Indies, but the emancipation of the slaves and the fall in the price of cloves ruined the colony. It is now a mere penal settlement—a large prison, guarded in front by the muddy ocean swarming with sharks, and in the rear by a trackless, tropical wilderness. Coolies from Pondicherry, Arabs and Berbers from Algeria, negroes and Frenchmen fill the prisons or work in chains on the roads. A strong force of young soldiery, many of whom find a grave in its sun-baked soil, a sprinkling of liberated European convicts who mostly become traders, many negroes and mulattoes, a few Indians and Chinese, and the Government officials form the heterogeneous population.

The old town is composed of a huddled mass of ricketty wooden tenements, parched and shrivelled by the intense sun, but by their carved balconies and chalet-like appearance bearing evidence of the music and romance of other days. Besides these old relics there are the later sheds and huts of the poorer people, surrounded by rude palings and gardens, in which the splendid foliage of the banana, the bread-fruit, and the mango put these vile erections of man to shame. The other buildings of the town are the residences of the Governor, Mayor, and other officials, the barracks, prisons, and Catholic churches. There are one or two fine grassy squares, shaded by avenues of lofty palmistes, and an immense graveyard surrounded with luxuriant fences of bamboo, most eloquent of the fatal climate, its well-kept tombs ornamented with china vases and *immortelles*, and planted with frangipanni.

When we got to Cayenne we found a veritable gold fever raging there. A few months before, rich surface diggings had been discovered in the woods on the banks of the Cinamari River, some seventy miles from Cayenne; large fortunes had been made by the French officials, who had, we were told, kept the affair jealously quiet. A party of American miners had, however, found out the secret and prospected the locality. Eight of these had left in the mail steamer for home on the very day of our arrival, having made their "pile." More gold, and also rubies, emeralds, and sapphires, had been likewise discovered on the Oyapok, and fortunes were to be made in a few months. The only drawbacks were the deadly malaria of the forest, and the difficulty of transporting provisions in canoes up the Cinamari, for the diggings lay beyond the rapids. But the dry season had now set in, the malaria was sublimed away, and it was no hardship to sleep in a hammock under the branches of the trees on a warm tropic night. In Cayenne a claim could be bought from the authorities for a few pounds, and negroes in abundance could be found to do the digging!

All this we learned from the telegraph staff we found at Cayenne waiting for the cable which it would be their duty to operate. They had all caught the gold fever, and cared little, perhaps, whether the cable were laid or not. The chief, whom I shall call Duxbury, since he had last hailed from Duxbury, U.S., the American station of the French Atlantic cable, had formed a partnership with his first lieutenant, Jericho, an Americanised Englishman, who was reputed to have fought under the flag of the Southern Confederacy, and had of late been a telegraph clerk in Demerara. They had bought a claim, and engaged a Californian miner, attracted from the Rocky Mountains by the glitter of gold. Jericho's brother had been sent for from America to go with St. Clair to the mines, and the expedition was being got ready with all haste.

We sat in the rooms of Duxbury, Jericho, and Co., drinking iced claret and hearing their golden plans. Spades, mattocks, and washing pans, for the mines, were mixed up in the corners with galvanic batteries and telegraph instruments. A *carte des terraines auriferes* was spread out upon the table, with all the claims marked out and three black dots ∴ on every one in which gold had been found. "This is ours," said Jericho, sketching it out with the end of his cigar, "this piece on the bend of the stream. It is next to No. 9 where Black Pete took out £6,000. We only got it from the French authorities because we were bringing the cable to them. There's a fortune in that little piece of earth. Yes, sir! fifty cents a pan, and a wooden pan at that."

(TO BE CONTINUED.)

THE EASTERN AND SOUTH AFRICAN TELEGRAPH COMPANY (LIMITED).

The first yearly ordinary general meeting of this company was held on Tuesday, the 4th January, 1881, at the offices of the company, 66, Old Broad-street, under the presidency of John Pender, Esq., M.P.

The CHAIRMAN opened the proceedings by formally requesting the Secretary to read the notice convening the meeting.

The SECRETARY (Mr. George Draper) read the notice, and subsequently, read the minutes of the last meeting, and the latter were confirmed.

The CHAIRMAN moved the adoption of the report, and that, as recommended by the board, a dividend be declared of three shillings per share, making with two interim dividends already paid, a total payment of nine shillings per share in respect of revenue for the nine months ending 30th September last, being at the rate of six per cent. per annum free of income tax.

Vice-Admiral Sir LEOPOLD G. HEATH, K.C.B., seconded the motion, which was carried unanimously. The retiring directors, Sir Daniel Gooch and Col. T. G. Glover, R.E., were re-elected, and Messrs. Deloitte, Dever, Griffiths, and Co., were elected auditors. This ended the business of the meeting, when Mr. Bevan proposed a vote of thanks to the directors and the chairman, who, in replying, said:—We are greatly obliged to you, and the business being so satisfactory is the best reward we can have. "It is an ill wind that blows no one good," and in the present instance, while we must all very much deplore the war, we must confess that the recent and present unsettled state of South Africa has tended very materially to increase our receipts. Our hope is that, as the Cape begins more fully to appreciate the value of telegraphic communications, the exceptional state of traffic will be maintained by a large increase arising from commercial operations. Politically, at the present moment the gain to the Government is enormous. Without the telegraph, instead of sending one or two regiments, we might be without accurate information, and sending more than is necessary. The value of the telegraph was never before more realised, and I hope more appreciated by the Government than now.

The proceedings then terminated.

THE CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED).

The report of the directors for the half year ending 31st December, 1880, to be presented at the nineteenth ordinary general meeting of shareholders to be held on the 19th day of January, 1881. The directors beg to submit, duly audited, the balance sheet and accounts for the half year ended 31st December last. From these it will be seen that the gross receipts, including the balance brought from last account, amount to £17,389 19s. 11d., and the gross expenditure to £7,128 2s. 1d., leaving a sum of £10,261 17s. 10d. to the credit of revenue account. The above amount of £7,128 2s. 1d. includes, however, the sum of £3,379 7s. 9d., expended in the attempt to repair the Cienfuegos-Santiago section of the original cable, which the shareholders will recollect broke down in March last, the ordinary expenses (£3,748 14s. 4d.) being about the same as usual. The directors regret to report that the attempt to repair this section has been unsuccessful, owing to the cable east of Cape Cruz being in such bad condition as to render it almost necessary to renew the whole of that portion. In order to avoid this great expense, and finding that other parts of this section are not in altogether a satisfactory condition, the directors have entered into a contract by which Messrs. Hooper, of Hooper's Telegraph Works, are to lay and maintain another cable between Cienfuegos and Santiago, on terms which the directors consider will be advantageous to the Company. After placing £2,500 to the reserve fund, increasing that fund to £35,365 5s. 8d., and providing for the dividend on the preference shares, a balance of £4,761 17s. 10d. remains, out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 5 per cent. per annum, free of income-tax, leaving the sum of £761 17s. 10d. to be carried forward to the current half year's account. A comparative statement accompanying the report of traffic shows that the interruptions to several of the cables of the West India and Panama Company have been more protracted than usual during the past half year, which accounts for the great falling off in the traffic.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES JAN. 12.		BUSINESS DONE WEEK ENDING JAN. 12. Highest.		Lowest.	
Anglo-American Ordinary	60½,	1½	61		59½	
Do. "B"	88½,	9	88½		87½	
Do. "A"	33,	½	33		31½	
Brazilian	9 13-16,	15-16	9½		9½	
Cuba	8½,	9	—		—	
Do. Ten per Cent. Pref.	16½,	17½	—		—	
Direct Spanish	2½,	3½	—		—	
Do. Ten per Cent. Preference	12½,	½	12½		12½	
Direct United States	11½,	½	11½		10½	
Eastern	9 13-16,	15-16	10		9 13-16	
Do. Six per Cent. Debenture	102,	106	—		—	
Do. Five per Ct. do. 1899	102,	105	—		—	
Do. Six p Ct. Pref	12½,	13	12½		12½	
Eastern Extension	10½,	½	10½		10½	
Do. Six per Ct. Deb	110,	113	110½		110½	
German Union	10½,	½	10½		10½	
Globe Telegraph & Trust	6½,	½	6½		6 7-16	
Do. Six p Ct. Preference	12,	½	12½		11½	
Great Northern	10½,	11	11		10½	
Indo-European	25½,	26½	—		—	
Mediterranean Extension	2½,	3½	3 3-16		2½	
Do. Eight p Cent. Pref	10½,	11½	11½		11	
Reuter's	10½,	11½	11½		11	
Submarine	263,	268	265		265	
West India and Panama	1½,	2	2		1½	
Do. Six per Cent. 1st Preference	6½	7½	7		7	
Western and Brazilian	7½,	8½	8½		7½	
West. Union 7 p. Ct. 1st Mt.	120,	125	—		—	
Do. Six per Ct. Sterg.	104,	107	—		—	

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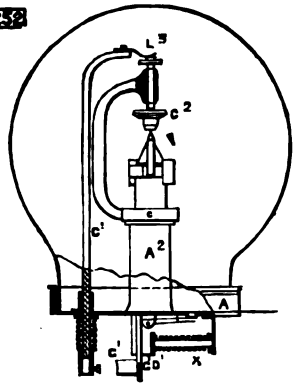
ABSTRACTS OF SPECIFICATIONS.

—o—

2252. IMPROVEMENTS IN ELECTRIC LAMPS.—*By George Guillaume André and E. Easton.*

According to this invention one or more lengths of carbons are placed end for end, socketed or otherwise, in a tubular holder, which supports them throughout their length, and wherein they can slide as required. For carbons which have to be propelled upwards the holder is formed with a longitudinal slot, wherein works a peg projecting from a sliding sleeve suspended by a cord which passes over a pulley, and has a weight attached to its end. The weight may slide on a guide rod or rods, which may be used for connecting the current. The holders are removable, so that they, as the carbon therein is consumed, can be replaced by filled ones, and thus avoid the breakage of thin carbons in

2252

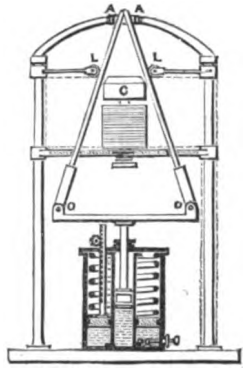


transport, and save time and trouble in refilling the holders. If found convenient, at least two filled holders may be placed in the lamp or lamp post when starting. When the carbon in the one holder has been consumed that holder is removed for refilling, and the other or filled holder is meanwhile brought into action. In order to prevent or diminish the disturbing action which now takes place when a carbon point breaks, say, from inequality of the material, or from great increase in the current strength, or when a fresh carbon is brought into action, we apply a fly or other regulator or brake to the pulley for the cord weight. A is a plate upon which is the lamp cover, A^2 is also secured on to A. C and C^1 are arms, C^1 making contact with negative electrode C^2 through spring L^3 and coil X to terminal. D^1 shows carbon holder in cylinder G^1. The carbon is actuated by a cord over a pulley, and regulated by a brake.

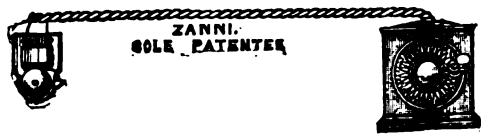
2271. IMPROVEMENTS IN ARTIFICIAL ILLUMINATIONS, &c.—*By Joseph J. W. Watson.*

This invention has for its object securing increased luminous power by the use of electricity in the flames arising from combustion as used for lighting purposes generally. The invention is specially applicable to the flames proceeding from any compound combustibles of the class of hydrocarbons, whether existing already as permanent gas or in a solid or liquid state previously to being converted into a gas or vapour by means of a wick or otherwise (as, for instance, in using fats and their derivatives, stearine and stearic acid, margarine and margaric acid, palm oil and its constituents, palmitin and palmitic acid, cocoa nut oil, cocinin and cocinic acid, spermaceti wax, paraffin, animal and vegetable oils of all kinds, all the so-called mineral oils, the oil of turpentine or camphine, coal tar, naphtha, benzole, or, in fact, any of the substances used in the shape of candles or fluids for burning of the hydro carbon class, and which may be thus converted through the agency of a wick or otherwise into a gas or vapour whilst undergoing combustion), but electricity may also be employed in connection with flames proceeding from simple substances, as, for example, hydrogen or carbon

2271.



burnt to carbonic oxide, or those arising from such compound substances as may number among their elements more than merely hydrogen and carbon (to wit, those which contain in addition oxygen, and even other elements), as in the large family of alcohols. In carrying out the said invention burners are used which will admit of the illuminant it is intended to employ being converted into a flame most suitable for the purpose, and preferably, if coal gas be used, of the description of jets known as "fish tails" and "bats' wings," arranged so that their flames may insersect at various angles, the object to be attained being the generation of a solid flame surrounded on as many sides as possible by the air; thus three flames may cross each other at angles of one hundred and twenty degrees; or they may form in plan an equilateral triangle, having a hollow in the centre, the flame itself being solid and continuous, as in an "argand," or four flames may be arranged to coalesce by their edges meeting in the centre, &c. If the combustible used be of a solid or liquid form then the disposition of the wicks is arranged so as to arrive at the same results so far as regards the flames to which they contribute; and such being the arrangements concerning the flames to which an electric current is to be applied the modes of effecting this application are as follow, it being premised that the most thorough dissociation of the carbon from the hydrogen forms the object, and that the current may therefore be applied to the flames either to act electrolytically in an independent passage through them or in a path provided for it, but offering sufficient electrical resistance to secure by its incandescence the required dissociation as an effect either of heat and electricity combined or of heat alone. For affecting flames electrolytically the inventor leads into them a powerful induced current derived from the electro magnetic coil machines known as "inductoria," or from magneto electric machines, or from electro static machines of the inductive class, or from dynamo-electric machines arranged with supplementary inductive coils so as to secure high tension or "density" at their poles, resulting in disruptive discharges when properly arranged. The points of the electrodes should be disposed in the flames so that the discharge shall take place through the greatest breadth of the same, thereby affecting the largest area of combustion, but passing primarily into the non luminous or dark parts of such flames (where merely heated gas exists), and where dissociation of the carbon and hydrogen have not yet commenced; thus in a "bat's wing" or "fishtail" flame simple the induced current would discharge along its longer axis, and at such striking distance as that, having due regard to the conducting power of the flame, the discharge would embrace in its action the largest area of action with the highest effect. He also constitutes the flames themselves electrodes, that is to say, he places two or more flames in juxtaposition, leading the poles of the induction coil or other source of the induced current into them, but arranged so that the line of discharge shall take place through the points at which such contiguous flames shall intersect or coalesce. In this manner it may be considered that any single flame or group of flames act (as the case may be, according to the nature of its connection with the source of the current) as the positive or negative pole, or, in other words, the "anode" or "cathode" relatively to the fellow flame or group of flames which permit of the circuit being completed. "Bats' wings," "fishtails," or "fan-shaped" flames, or even those formed by "union" and other "pipe-shaped" jets may thus serve, so to speak, as dectrodes, but he prefers to employ the transverse discharge between intersecting flames. Where the electric arc proper is to be used with a gas flame, a lamp as shown in the figure is used. A A shows the gas jets; the carbons hinged at O are guided by L L on the one side, and the steatite or porcelain disc on the other. The motion of the carbons is obtained as shown.

ZANNI  & CO.,

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Southampton-buildings, Chancery-lane

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SLIP

THE PHOTOPHONE.—A patent has been granted in America to Professor Bell for this instrument.

PARIS, 1881.—What is England doing to promote the success of the Electrical Exhibition and Congress?

ROYAL INSTITUTION.—Mr. Warren De La Rue last night delivered his discourse on "The Phenomena of the Electric Discharge with 14,400 Chloride of Silver Cells."

THE TELEPHONE COMPANY AND THE POST OFFICE.—Negotiations are understood to be still going on between these parties. It does not appear that the threatened appeal against the recent judgment is being proceeded with.

SUBMARINE TELEGRAPH COMPANY.—The Submarine Telegraph Company have removed their offices to No. 2, Throgmorton-avenue, London-wall, and messages are now received there from the public for transmission to the Continent.

AMALGAMATION OF U.S. TELEGRAPHS.—The *Standard* reports that the terms of an agreement for the consolidation of the Western Union and American Union Telegraph Companies have been drawn up, and that the preliminary papers have already been signed.

THE SNOWSTORM.—The unprecedented snowstorms and gales raging during the early part of this week have caused extensive interruption of telegraphic communication throughout the country, and when we went to press public notice of delay to all parts was still in force.

THE PROJECTED ATLANTIC CABLES.—From several quarters we have received intimation that our last week's announcement of two new cables having been ordered was premature. On the other hand we have positive assurance that at least one such cable has actually been ordered, and probably two.

THE ELECTRIC LIGHT IN THE CITY.—Permission has been given to the Brush Electric Light Company to lay down the necessary wires underground from their factory, Vine-street, York-road, Lambeth, along Stamford-street, &c., for the lighting of the various city streets, as arranged with the Sewers Commissioners.

PRICES.—The prices of gutta percha as quoted are :—For genuine 6d. to 3s. per lb., for reboiled 2d. to 1s. per lb. India rubber, per lb.:—For Para (fine) 3s. 1d., Negrohead 2s., Central Ameican 1s. 8d. to 2s. 4½d., Assam and Pegu 1s. to 1s. 10d., other East Indian 1s. 6d. to 2s., Madagascar and Mozambique 1s. 6d. to 2s. 3d.

PERSONAL.—Mr. Alfred R. Bennett, M.S.T.E., late engineering superintendent to the United Telephone Company, has been appointed the engineer and manager of Messrs. D. and G. Graham's telegraphic and telephonic system, which already extends over Glasgow and for thirty miles around, and is said to be on the eve of considerable development.

THE ELECTRIC LIGHT.—Arrangements have just been completed with the British Electric Light Company for the experimental lighting of certain important parts of the General Post Office, St. Martin's-le-Grand. The first series of the experiments will be conducted in the telegraphic instrument galleries. The Brush system is also to be tried.

THE RONALDS LIBRARY.—A curious instance of the difference between nominal and intrinsic worth is furnished by the probate valuation of this important gift to the Society of Telegraph Engineers. The whole of the books, &c., included in the bequest were estimated at £146 7s. For once in a way the legatees cannot complain of exorbitant legacy duty.

ROYAL POLYTECHNIC INSTITUTION.—This venerable institution is still vigorous, and we can always rely upon obtaining an instructive and an amusing evening by a visit. Mr. King is now discoursing and experimenting upon great induction coils and an electric railway which traverses the building. These are things worth seeing illustrated by facts worth knowing.

REPAIR OF THE FRENCH CABLE.—The Brest-St. Pierre cable of the Compagnie Française du Télégraphe de Paris à New York was repaired on Sunday night, at a distance of forty miles from Brest, by the French company's repairing steamer "Pouyer-Quertier," under the direction of Mr. Diesel horst, engineer in charge of the staff, who was sent last week to Havre for that purpose.

INTERNATIONAL ELECTRICAL EXHIBITION.—The consulting committee for this undertaking has just been nominated by the French Government, and comprises a number of names of the leading men of science. The Commissioner-General is M. G. Berger, who took so prominent a part in the International Exhibition of 1878. Four vice-presidents are selected—Admiral Pothau, M. Teisserenc de Bort, M. Brisson, and M. F. de Lesseps.

LIVERPOOL DOCKS.—The system to be used for the electric lighting of the new portion of the Liverpool Docks is the Gramme. Mr. Killingworth Hedges, C.E., made a series of experiments with this and other systems for the purpose of ascertaining which was most suitable for the lighting which comprises the dock entrance, sheds, and graving docks. The plan submitted having been approved of by the board, the work is to be commenced at once under Mr. Hedge's superintendence.

STRANGE TREATMENT OF A HOSPITAL PATIENT.—Under this heading the newspapers report that several of the jurymen at a recent inquest, held in Westminster upon George Seamar, aged 41, a pianoforte maker, expressed a strong opinion that the "application of a battery" to the patient, who was suffering from severe injuries in the head, was a highly improper proceeding on the part of the Charing Cross Hospital surgeons. At the coroner's suggestion, however, a verdict of accidental death was ultimately returned.

TELEGRAPH TO THE WEST INDIES.—A deputation of West India proprietors and merchants recently waited upon the Earl of Kimberley, at the Colonial Office, to urge the great importance of an efficient maintenance of telegraph communication between the United Kingdom and the West India Colonies. Mr. Charles Tennant, M.P., introduced the deputation, and there were also present Mr. T. D. Hill, chairman of the West India Committee; Mr. Lubbock, deputy chairman; and a number of other gentlemen interested in the colonies.

THE PHOTOPHONE.—M. Mercadier has made a second communication to the Academy of Sciences on the subject of Prof. Graham Bell's latest discoveries. According to *L'Electricité* the photophone is now proved to be a veritable thermophone. The proof seems to consist in the fact that the interrupted rays of a gas jet, or heated body, projected on to a disc of either glass, zinc, or mica give rise to audible sounds. We think the fact was already known in this country; but it has not been understood to explain all the phenomena of the photophone.

STEAM ENGINES FOR DRIVING ELECTRIC LIGHT MACHINERY.—Messrs. Ransomes, Head, and Jefferies, of the Orwell Works, Ipswich, have just issued an illustrated catalogue of a variety of types of steam engines, constructed specially by that firm for use in driving electric light apparatus. The

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engines, illustrated and described, include engines of the following classes ;—Portable, semi-portable, special-portable-fixed, vertical, horizontal, stationary, &c. We have often spoken of the excellent work performed by the engines of this firm, as, for example, those on the Thames Embankment, at South Kensington, &c.

THE "YEAR BOOK OF PHOTOGRAPHY."—This annual, edited by H. Baden Pritchard, F.C.S., must be pronounced excellent from a photographer's point of view, containing, as it does, a vast amount of compendiously arranged information and articles specially suited for the profession. In the current issue is an interesting paper by Mr. J. W. Swan, whose name has recently become so prominent in connection with the electric light. Mr. Swan writes on the use of the electric light in photography. He believes that before long the electric light will be within easy reach of photographers to help them when the sun is not available.

A SPIRITUAL TELEPHONE.—Commenting upon a recent case of imposture and extortion in this country, *L'Electricité* professes to describe a method of producing vocal sounds in any given spot by affixing to it an electro-magnetic arrangement connected with a telephone or microphone in another room. The device seems feasible enough, but we are afraid it will not be convincing, unless we are to suppose that the spiritualists were masters of telephony and microphony long before Graham Bell's or Professor Hughes's time. In any case, we do not propose to furnish details of the contrivance, for if it is not an explanation it might serve as a tempting suggestion for fraud.

THE HOUSES OF PARLIAMENT AND ELECTRIC LIGHTING.—In reply to a question on the subject on Friday, the 14th inst, Mr. S. Lefevre said that a few days before the meeting of Parliament experiments were tried with the electric light at the House, on the American Brush system, when six globes were placed a few feet below the roof. On personal inspection he came to the conclusion that the glare of light was a great deal too strong; and he felt that he could not recommend its adoption. The company had since offered to test the light above the glass roof, and he proposed that this should be tried on some convenient Wednesday after the rising of the House, when hon. members would be able personally to inspect the operation.

BRITISH ASSOCIATION REPORTS.—The volume containing the reports of the Cardiff meeting has recently been issued, and contains several interesting papers on electricity, among which we may mention the preliminary report "On the Inductive Capacity of a good Sprengel Vacuum, &c.," a "Report on Curves of Declination Magnetographs," by Professor W. G. Adams; "An Account of some Experiments in Photo-Electricity," by G. M. Minchin, M.A.; "On the Proper Form of Lightning Conductors," by W. H. Preece; "On Electric Convection-Currents," by S. P. Thompson; "On the Necessity for a Regular Inspection of Lightning Conductors," by R. Anderson; "On the Theory of the Induction Balance," by Lord Rayleigh; "On a Method of Measuring Contact Electricity," by Professor Sir W. Thomson, F.R.S., some of which papers have been given in previous numbers of *The Electrician*.

THE ST. GOTHARD TUNNEL.—The question of the electric lighting of the St. Gothard Tunnel is not yet settled, two systems being still under consideration. The first project, which appears to be the more practical, is that of a direct electric current produced by compressed air passing through the whole length of the tunnel, with 40 lamps, each having an illuminating power of 1,200 candles. The second plan proposed is the employment of a movable electric light This is to be obtained by means of a locomotive, driven by compressed air, supplied from turbines of 1,000 to 1,200 h.-p. fixed at both ends of the tunnel. Sufficient force is needed to drive the locomotive, and also to give the power required by two electric motors, which it carries. These would produce two lights, each equal to 12,000 candles. The light would be divided before and behind by two reflectors, and would be sufficient to light a considerable distance.

MANCHESTER.—During the past week a series of experiments has been carried on at the Victoria station with the object of illuminating the structure with the electric light. The arrangements admit of eight powerful lamps being brought into use. These lamps are suspended from the girders of the roofs over the Lancashire and Yorkshire Company's departure platforms, and at the arrival platform in Great Ducie-street. The electricity is generated and conveyed to the lamps by means of four Gramme machines, which are driven by a powerful portable engine. At present these operations are carried on in a portion of the Old Fish Market in Great Ducie-street. It is proposed to bring ten lamps into use, and these, it is believed, will be sufficient to properly illuminate the whole of the Lancashire and Yorkshire Company's platforms. The work is being carried out by the British Electric Light Company.—*Manchester Examiner.*

CITY GUILDS INSTITUTE.—Professor Ayrton's course of instruction during the spring session deals principally with electrical and cognate subjects. On Tuesdays he deals with "Electrical Instrument Making;" on Fridays with the "Electric Light;" on Mondays with Motor Machinery, referring especially to that employed in electric lighting and the electric transmission of power; on Wednesdays classes are held for a Junior Course in Electricity and Magnetism. We have before us the syllabus of the work to be done, and feel astonished at its scope. Really the young men of the present day have facilities such as their fathers never dreamt of for obtaining information. Our advice to all engaged in electrical pursuits is—make yourselves intelligently and thoroughly competent for your present position, *then* get all the information required to render you competent to fill the position next above you. The spring term of the Institute commences on the 24th January.

THE POST OFFICE TELEGRAPH CLERKS.—In accordance with a resolution passed at a preliminary meeting of the clerks of the Central Telegraph Office, held at the Ship Tavern, Ivy-lane (*vide Electrician*, Jan. 15, page 97), a further meeting was held on Saturday evening, in the Lecture Hall of the Young Men's Christian Association, Aldersgate-street, which was attended by about 500 operatives of all classes, presided over by Mr. A. S. Coates, senior clerk of the central station. The object of the agitation is to protest against the grievances under which the staff in the Telegraph Department assert that they are suffering—the chief of which are understood to be the receipt of inadequate salaries, and the stagnation of promotion. The report of the provisional committee, read by the secretary, stated that the appeal for subscriptions had been generously responded to. It also stated that numerous applications had been received from female clerks who desired information as to the best means of obtaining an amelioration of their condition. The chairman said their "platform" was based on the Telegraphs Act, which was passed to deal with the transfer of the telegraphs from private companies to the service of the Crown. They had taken legal

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opinion on the several Acts and their clauses, which provided that such telegraphists as had been handed over from the original companies to the State were entitled to be considered officers and clerks in the Civil Service. He advocated the presentation of a memorial to the Postmaster-General embodying their claims and stating the grounds on which they were founded. If those claims were once admitted they would be entitled to all the privileges of the Civil Service. Until within the last few years they had been called clerks, but suddenly and without warning that title had been changed, and they were now called "Telegraphists." He did not know what they had done to deserve that title. Why, Sir Stafford Northcote himself, when Chancellor of the Exchequer, in reply to Mr. Dillwyn in the House of Commons, admitted that the telegraphists were a "clerical body."

How to Increase the Interest taken in the Electric Light.—One of the most enterprising and best conducted of provincial papers, the *Newcastle Weekly Chronicle*, from time to time offers small prizes for essays on subjects of current interest. The essays are required to be short, and the prize essays are published. Last week the subject was "Is it Probable that the Electric Light will ever be Available for Domestic Purposes?" The first prize was given to the essay by R. Blackett, Manors, Newcastle, which we reprint:—"The advance which the electric light has made during the last few years is almost entirely due to the improvements in electro-magnetic machines. When Davy, in 1801, discovered the voltaic arc, he knew nothing of this cheap and powerful method of generating electricity. Faraday, in 1831, discovered the principle, and Holmes was the first to put it into practical use as a source of electricity for the electric light. With his electro-magnetic machine he lit up the first lighthouse that was illuminated by this wonderful light. Since then inventors have greatly improved both the generators and the lamps. The electric light in its present form may be simply described in the following manner:—Motive power, such as a steam or gas engine, is made to drive or rotate an electro-magnetic machine, which generates the electricity and sends it along the conducting wires to the lamp, where it is expended in making the carbons white hot, and thereby producing the brilliant light. Sometimes one engine and machine is made to supply, by a peculiar arrangement of the conducting wires, the electricity for several lamps. This is what is called the subdivision of the electric light. The extensive application of this, the purest and most powerful, of all artificial lights, to the illumination of large spaces, such as workshops, quays, streets, docks, &c., fully proves that it has established its utility for this purpose. The arc lamp, which is used in such situations, is well known to be unsuitable for domestic use, owing to the necessity of having to renew the carbons as they burn away. The best of the arc lamps are also liable to flicker or become unsteady, and although this is not so important for out-door illumination, it would never do for reading, sewing, or other similar domestic amusement or employment. This flickering of any one light affects all the other lamps that are on the same conducting wire. There are also great difficulties in the subdivision of the arc lights. The only suitable lamp at present known is the incandescence lamp, and by far the best form of it is the one recently described by our townsman, Mr. Swan. His lamp is as yet only in its babyhood, but although not near perfection, it is, as far as present knowledge teaches us, in the right direction; for the electric light of the future will very probably be incandescent carbon enclosed in a vacuum, or at least secured from contact with air. Carbon is far superior to any of the refractory metals that have been used. Its very blackness is a virtue, for Professor Balfour Stewart says:—'The blacker the body is the brighter will be its light when incandescent.' It is now also believed that it is impossible to burn or consume the carbon if the air (or the oxygen of the air) can be kept from it. It is a mistake to regard the combustion of the carbon in the voltaic arc as a great source of light, for it is only the solid particles of carbon that give the dazzling light, the stream of vapour adding very little to it. The incandescence lamp, as at present made, is not so economical as the arc lamp, simply because it will not withstand a very intense current of electricity; but this is no fault of principle, but of construction. The defect will in time be remedied, for now it may safely be taken as a fact that, after a theory or principle has been discovered and explained, there are always plenty of clever mechanical geniuses able and willing to put it into practical form, if there is any encouragement to do so. This will be quite true as regards both the incandescence lamp and the distribution and regulation of the electric current. Theoretically they are easy, and it cannot be doubted that in a little time they will be practically established, so as to produce and distribute the light in an economical manner. There seems to be only one problem left for our chemists and scientists to solve, and that is the devising of a means to store the electric current so as to have it always ready for emergencies. But this may possibly be overcome in a purely mechanical manner, by having some suitable accumulated power in reserve. This single exception to a perfect electric light for domestic use almost proves the rule that this beautiful, healthy, and comparatively safe light will certainly advance, and will, in time, become the favourite light of our homes. There is nothing more difficult, or perhaps unwise, than to prophesy; but any scientific person, carefully weighing the *pros* and *cons* of this question, cannot very well come to any other conclusion than that the electric light will surely take the first place in artificial lighting. It is as pure as sunlight—the spectra being the same—and it connot in the the slightest degree (in the incandescence form) injure the health of persons or plants. Nor does it emit anything injurious to delicate fabrics, pictures, &c. No light could possibly give less trouble to the user, for there is no need to 'search for the matches' in order to 'light up.' This may seem a small matter, but it really rids us of a great nuisance. The recent scare about the danger to life by the electric light is merely a scare, for it applies only to the conductors of a very powerful arc light. It is no doubt dangerous to touch these, but there cannot possibly be anything dangerous to life in connection with the small lamps which will be used for general purposes. There is a slight danger of any very weak part of the conducting wires becoming hot and setting fire to anything combustible near; but this danger is more apparent than real. Columns of facts and figures might be given to show the superior economy of electricity over gas, but such an array would answer no good purpose. It need only be named that, if a certain amount of coal is taken and converted into gas-light, and then an equal amount of coal converted into electric light, both in the most economical manner, the electric light will give a hundred times more light than the gaslight. It is not likely that gas-lighting, which is just another form of incandescent carbon, will ever become a curiosity, but it may very safely be said that, under many circumstances, the electric light will be more economical than any other artificial light now known, and, consequently, a purer and better light for domestic purposes."

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LITERATURE.

Les Telegraphes. Par A. L. TERNANT. [Hachette and Co., Paris, 1881.]

This little book is one of the series of the *Bibliothèque des Merveilles*, published under the direction of M. Edouard Charton, and as such is intended, we presume, more for the information of the general reader than for technical education. It gives a very good general sketch of telegraphy, commencing with the most ancient forms, proceeding with the various steps and improvements up to the latest. But although it is thus comprehensive there is much that may be useful to the student of electric telegraphy. Mr. Ternant, at present in charge of the Eastern Telegraph Company's station at Marseilles, has had the advantages of considerable experience on English lines, and was for some years in the service of the Indian Government on the Persian Gulf line. His connection thus with submarine telegraphy and his knowledge of English have enabled him to take proper advantage of the English Literature on the subject, not merely from books but also from papers read at institutions; and in some of his chapters on submarine telegraphy he has indeed popularised with considerable skill information from the minutes of English societies such as the Institution of Civil Engineers, which has been left untouched by our English compilers of books on telegraphy. The first part gives the history of optical telegraphy. Alluding to early telegraphy, Mr. Ternant informs us that "the Arabs and Asiatics practised the art of speaking by means of visual signals, and the Chinese had erected fire machines on the great wall to give the alarm to the whole frontier separating them from the Tartars when threatened by these hordes. They employed, as well as the Indians, such brilliant fires that they could penetrate fog, and which neither wind nor rain could extinguish. The English having brought from India the receipt for these fires (probably porte fire composition or blue lights, which the French term *Flammes de Bengal*), used them in the operations made in 1787 for tying trigonometrically the observatories of Paris and Greenwich. These operations, conducted by MM. Cassini, Méchain, and Legendre on one side, and by General Roy and Mr. Blagden on the other, allowed not only the work of a perfect triangulation by means of these fires, and even by common lamps with reflectors, but there took place besides an exchange of signals between the two coasts of the Pas-de-Calais. The possibility of telegraphic communication across the Straits of Dover was, therefore, demonstrated as early as 1787."

Francis Kessler (but at what date our author does not state) appears to have been the pioneer of the flash telegraph used by the armies and navies of the present day. He placed a lamp in a barrel with a movable shutter, by which he could eclipse the light at will. Two flashes stood for A, three for B, &c. There is much more that is interesting in this historical part. Chappe's semaphore is fully treated historically. Aerial telegraphy was used by the French in the Crimea, where the English had run a gutta percha wire from Varna, and thus the old and the new system were found together. Passing to flash signals from lamps, Mr. Ternant gives some interesting particulars of the modes used in France, and then passes to the heliograph, and gives the credit of priority of invention to M. Leseurre, telegraph inspector, who first used it in Algeria. This system was described in the *Comptes Rendus* on June 16, 1856, and is also described in the *Annales Télégraphique* of October, 1855. Mr. Mance's heliograph, which is more simple, is described and its merits discussed.

Acoustic telegraphs are next dealt with, and Mr. Edison might be surprised to hear that in 1670 the Chevalier de Morland made a present to the King of England of a speaking trumpet which allowed words to be heard at a distance of a mile and a half, against the wind, from where the words were uttered. Mr. Ternant mentions that the string telephone, which a few years ago was in everybody's hands, appears to have been foreshadowed by Robert Hooke in 1867, but the quotation given only mentions the conveyance of sound, not speech. Traces of the string telephone, our author says, have been found amongst the savages of America and in the extreme East. This reminds the writer of this review that he had this little instrument brought to his notice by a naval officer (Captain Benest) who had received one from Peru when it was in full *furore* some time before the Stereoscopic Company brought it out. Captain Benest, at the writer's advice, took it to the Stereoscopic Company. It was new to them, and they experimented on it, but treated the matter with coolness, and soon afterwards brought it out with great success, never, however, recognising Captain Benest in the matter.

Returning to our review, Mr. Ternant, treating of electrical telephones, alludes to the works of Du Moncel and Alfred Niaudet as excellent on this subject, and gives some brief historical notes leading up to Bell's telephone, and on the Gower-Bell instrument, which is well illustrated, as well as telephone office switches and fittings.

The third chapter treats of pneumatic telegraphs. According to l'Abbé Moigno, a Mr. Ador, in 1852, first sent despatches by pressure of air in the park of Monceau, and in 1854 M. Caly Cazalet, in France, and L. Clark, in England, took out patents for the system. The subject is well treated with several good illustrations and maps of the Paris and Berlin systems. We next come, in Part II., to electric telegraphy. The subject is treated historically, with considerable pains, starting from Schilling and Sœmmering, and proceeding to Cooke, Wheatstone, and Morse. Our author for this purpose has perused the rare little work of that indefatigable detective on the subject, Dr. Hamel. We are glad to see that our author places the Italian experimentalist, Romagnesi, of Trente, in his proper place as the discoverer of the effect of an electric current on the magnetic needle in 1802, which was for so many years credited to Œrsted, who was supposed to have made the discovery in 1820. There is much in this part of the work of interest to those who care for the history of the subject—and we trust most electricians do—and we are glad to find Mr. Ternant gives authorities, generally in foot notes. We do not, however, notice the name of Sir Francis Ronalds. Perhaps this is because the attempts of Sir Francis were made exclusively with electricity produced by friction, or else from a courteous feeling towards our English Admiralty, as the history of Sir Francis Ronalds would necessitate the reproduction of that unfortunate and much-quoted letter from Mr. Barrow, the secretary of the Admiralty, to Sir Francis, stating "that telegraphs of any kind are now wholly unnecessary," and then proceeding with such charming want of logic, "and that no other than the one now in use (the semaphore) will be adopted."

The submarine telegraph is alluded to historically up to the Dover and Calais cable, and our author states that Mr. Willoughby Smith claims (in the *Society of Arts Journal* of 23rd April, 1858) the first idea of the adoption of the wire sheathing. The construction of land lines is treated with good illustrations of insulators, shackles, posts, &c. The construction of cables is described, but this is rather a difficult subject to treat with, and the illustrations of machinery are, of course, merely sketches showing the principle. Still, there is a good deal here which, considering the difficulty of getting drawings, is so much more than has been published in a book before. Sections of cable are given. We notice that an illustration, giving the plan of a large telegraph cable works, is taken from Mr. F. C. Webb's plans for works proposed to be erected at the Millwall Docks (near where Hooper's works now stand), and with a nine tank ship for taking in cable direct from nine machines at once, and which was illustrated and described in *Engineering* about the year 1870. This plan was to avoid the recoiling of the cable three times, as adopted in using the "Great Eastern" for Atlantic cables. There are in Mr. Ternant's work illustrations of the "Monarch's" picking up gear, and some other illustrations from Mr. F. C. Webb's paper on "Submarine Cables," read before the Institution of Civil Engineers in 1858, and also an excellent one of the "Great Eastern's" double-drum picking up gear, used in 1866. Altogether there is a very fair description of cable laying and repairing, with illustrations of breaks, cones, and rings; but the longitudinal section of a cable ship, with tanks and deck machinery, we cannot help saying is horrible in its want of proportion.

Chapter four describes the general form of various batteries. Chapter five treats of instruments. Single needle mirror, siphon recorder, Morse, Wheatstone automatic, and Hughes are all more or less well described, and duplex is very well treated. Chapter the sixth gives some idea of the modern mode of testing, and the book winds up with sketches of fire and military telegraphs, &c.

The work is, as we have said, intended as a book on telegraphs for the French general reader, but Mr. Ternant has treated many parts historically with care, and, working with French sources of information, there is much historically, and a good deal technically, which may be useful to English electricians and engineers.

THE COSINE GALVANOMETER.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: So many claims have appeared from time to time in reference to the invention of a tangent galvanometer, the ring of which can be deflected from the vertical, that I think it may not be without interest to your readers to quote the following Paper from the *American Journal of Science and Arts* for 1871, by Professor Trowbridge, of Harvard College. I remark that this instrument, well known to electricians, has recently been patented in England as a novelty. Its use, however, is open to everyone; but a great objection to its application for measuring "dynamo"

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currents is the inaccuracy arising from the "dip" of the needle under the action of powerful currents.—Yours, &c.,

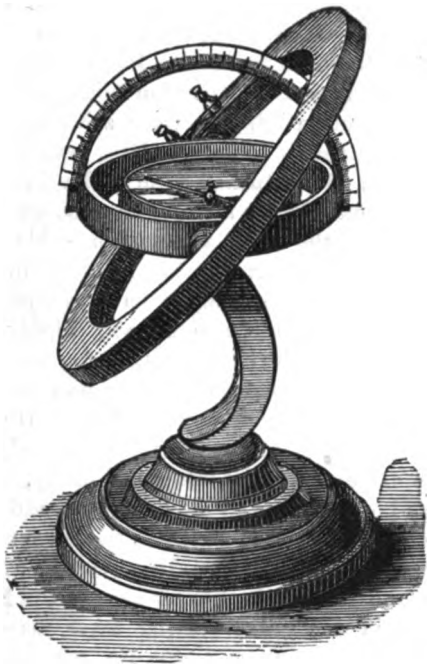
PAGET HIGGS.

New York City, Dec. 22, 1880.

A NEW FORM OF GALVANOMETER.

By JOHN TROWBRIDGE, Assistant Professor of Physics, Harvard College.

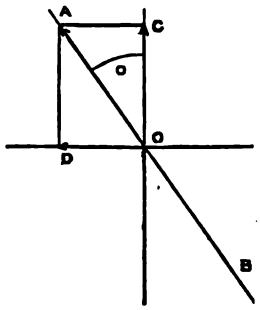
In the tangent galvanometer the plane of the coil standing perpendicularly to the plane in which the needle moves, the needle is deflected by the action of the current passing through the coil upon the current circulating in the magnet; the magnet being considered a solenoid according to Ampère's theory. The tangent of the deflection measures the intensity of the current. The defects of the tangent galvanometer are well known. The poles of the needle in being repelled are removed from the field of the current, and consequently with currents of great intensity the tangents are not closely proportional to the strength of the currents, the delicacy varying as the differential of $I = \tan.\theta$, or $\frac{dI}{d\theta} = \sec.^2\theta$. When the ratio of the length of the needle to the diameter of the coil is a very small fraction, the tangents, however, are closely proportional to the corresponding intensities.



In Gaugain's galvonometer, where the plane of the current is placed at a short distance from the axis of the needle, the intensities are directly proportionnl to the tangents of the deflections.

A mathematical investigation of the effects of electric currents on the magnetic needle, the plane of the current having different obliquities with regard to the horizontal plane in which the needle moves, led me to devise the following form of galvanometer:—

A magnetic needle is placed at the centre of a circular current, the plane of the current at first being horizontal. In this position the needle is unaffected by the current, and is acted upon merely by the earth's magnetism. We now turn the plane of the current about a horizontal axis passing through the centre of the needle as in the figure, A B representing the plane of the coil in its new position, inclined at an angle of $90° - \theta$ to the horizon.



It will be readily seen that if A O represents the intensity of the current passing through the coil, O C will be the component that will deflect the needle; but $OC = AO \cos.\theta = I \cos.\theta$. The intensities will, therefore, be proportional to the cosines of the inclination of the plane of the current, measuring the angle from the vertical O C.

The instrument with which I experimented had the following dimensions:—The diameter of the circle around which the current passed was 12 inches, and the length of the needle 1·4 inches. It was provided with long aluminium pointers. The inclinations of the plane of the current were read from a vertical scale perpendicular to both the plane of the current and to the plane in which the needle moved.

The manner of experimenting was as follows:—The resistance of the battery—one Daniell's cell—having been determined with care, and also the resistance of the circuit, the instrument was first used as a tangent galvanometer with the plane of the current vertical.

Resistances from 1 up to 10 ohms were introduced into the circuit, and the deflections noted; then with a constant resistance the angle was noted through which it was necessary to turn the plane of the current, until the same deflection of the needle was obtained as in the cases where the instrument was used as a tangent galvanometer with varying resistances.

The following table gives the results obtained:—

Ratio of Intensities.	Angles of Deflection.	Ratio of Tangents.	Error.	Angles of Inclination.	Ratio of Cosines.	Error.
	Deg. Min.			Deg. Min.		
·076	18 30 75 52	·090	·014	85 30 0 0	·078	·002
·142	32 15 75 52	·158	·016	82 0 0 0	·139	·003
·200	41 0 75 52	·226	·026	78 45 0 0	·195	·005
·333	54 35 75 52	·354	·021	70 0 0 0	·342	·009
·400	15 0 32 0	·428	·028	65 0 0 0	·422	·022
·529	14 30 25 30	·542	·013	57 0 0 0	·544	·015
·692	18 30 25 30	·701	·009	47 45 0 0	·672	·020
·810	21 30 25 30	·825	·015	38 15 0 0	·785	·025

It will be noticed that with large deflections the ratio of the cosines is nearer the ratio of the intensities than the ratio of the tangents. With smaller deflections, however, the ratio of the tangents is nearer that of the intensities than the ratio of the cosines. In the expression

$$I \cos.\theta = C\,O = \tan.\theta',$$

$$\text{or} \quad I = \frac{C\,O}{\cos.\theta} = \frac{\tan.\theta'}{\cos.\theta},$$

if we differentiate I with respect to θ, we obtain

$$\frac{dI}{d\theta} = \cos.\theta \frac{d.\tan.\theta'}{d\theta} + \sin.\theta \tan.\theta' \over \cos.^2\theta.$$

It will be seen that the delicacy varies inversely as the cosine of the inclination decreases, or, in other words, as the angle of the plane of the current with the vertical increases; the vertical component of the intensity increases while the horizontal component decreases. This vertical component thus renders the needle less sensitive to the horizontal component and dips it. By diminishing the length of the needle, and providing it with long pointers, and also increasing the diameter of the circle around which the current passes, the effect of the vertical component can be lessened.

With large deflections, therefore, this instrument appears to give closer results than the tangent galvanometer, and, therefore, supplies a deficiency in the latter instrument. By the cosine galvanometer many determinations of the intensity of the same current can be made by forming a table of the values of the cosines of different angles of inclinations in terms of the deflections of the needle, which currents with a known resistance interposed produce. In the tangent galvanometer but one determination can be made.

Irrespective of the accuracy of this method, the instrument can be viewed as supplying a break in the literature of the subject. We have now, in addition to the tangent galvanometer and the sine galvanometer, a cosine galvanometer.

My thanks are due to Professor Cooke, of Harvard College, for the generous use of his apparatus for electrical measurements.

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HENRY DENISON PENDER.

We regret to announce the death of Mr. H. D. Pender, second son of Mr. J. Pender, M.P., Chairman of the Eastern Telegraph Company, &c. Mr. H. D. Pender had recently acquired an interest in *The Electrician*, and had brought a considerable amount of energy to bear upon the business transactions of the paper. We found in him a constant and earnest desire to facilitate and to render our work effective. A short time ago, having obtained an appointment with the Eastern Telegraph Company, he visited their stations in the Mediterranean, and, as many of our readers on these stations can testify, spared no pains to elicit opinions upon questions conducive to the further success of this paper. We understand it was during his return journey, while at Rome, that the germs of the disease which ended so fatally were contracted. Immediately upon his return we had together discussed the diversity of opinions he had gathered, as well as other features of interest in connection with this journal. It was at Mr. Pender's suggestion that we decided from time to time to give as complete a list as possible of the cable fleet of the world. Truly, those whom the Gods love, die young, and it is with sad hearts that we write of the loss, at the early age of twenty-eight, of one who gave so fair a promise of a bright career. He died on the 13th January, at Footscray Place, Kent, the country seat of his father. He was born in October, 1852, and after the care of a private tutor, he entered Wellington College in 1867, and remained there four years. In 1872 he travelled in Russia with Mr. J. G. Dunn, and returned home through Sweden and Norway. After a short stay in London he again went abroad, this time by himself, but fortified by letters of introduction, which his father's influence readily obtained for him. He visited India, Australia, and New Zealand, and brought back with him a collection of curiosities sufficient to enable him to establish a museum. In the autumn of 1874 he entered the London house of Nicol and Co.; and in 1875, at their solicitation, he went to Bombay to their Indian branch establishment. He returned from India in 1878, and went out shortly after to Cyprus, where he established the first telegraphic cable communication. Returning to London in November, 1879, he left again on a special mission to Chili, in which he was highly successful, and returned, *viâ* Canada, to England. Henry Denison Pender was fond of ships, the sea, and all naval matters. He had in hand, well advanced too, an analytical index of ships of Her Majesty's Navy, which it was his intention to publish. It would have been a valuable book, giving to the naval reader in a compendious form all particulars, technical and historical, of every ship in the Navy. The mind which was weaving these materials into shape is now at rest. He recently lectured on torpedoes at Wellington College, and gave a special lecture on Cyprus to the students of the Working Men's College. Many who read these lines will remember how his musical talent has contributed to their enjoyment on various occasions. In common with almost all other travellers, he was a Fellow of the Royal Geographical Society. As a member of the Royal Naval Volunteers he distinguished himself in seamanship and gunnery. His remains were borne on Wednesday last to their quiet resting place in the little churchyard at Footscray, many friends following the simple *cortége*. All present will carry away a recollection of the sad scene—the premature end of a life of great promise, and the breaking asunder of dear and cherished ties. Amongst the mourners we observed Henry Edwards, Esq., M.P.; Sir James Anderson, George Farrar, Esq.; W. G. Hall, Esq.; C. Ellissen, Esq., &c. Deputations attended from the principal Telegraph Companies and from the Royal Naval Artillery Volunteers.

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NEW ELECTRIC RAILWAY SIGNALS.

If there is any falling off in English patents for new overland telegraph apparatus, there is apparently none for methods of working the signals of railways by means of electricity. Last year some thirty patents were taken out for plans of this kind, and several of these are worthy of special attention. The telephone, too, which in the ordinary Bell form has not met with much favour on railways, has in the more powerful form of the Gower-Bell been at length tried with success by the South-Western Railway Company. Ten years ago Mr. C. F. Varley, in a very suggestive patent, the worth of which will be more fully recognised by the historian of after years than by his contemporaries, described a mode of sending delicate undulatory electric signals over the the same wire on which the ordinary strong Morse signals were being transmitted, and by interpreting these riding signals in various ways, telephonic and otherwise, he solved the problem of di-plex telegraphy, and obtained two separate telegraph messages on the same wire. The Gower-Bell telephone is now applied to railway working in a similar manner. It is connected in multiple circuit with the line which works the block signals, and the delicate magneto-electric vibratory currents of the vocal message do not interfere in the least with the stronger block currents. The result is that the noise of a train's departure from a distant station can be heard on the telephone simultaneously with the bell which indicates the event.

One of the most important new methods is that of Mr. Spagnoletti, and consists in improved means of locking and interlocking signals on the block system by means of electrical and mechanical devices. He attaches to the signal frame a small wheel with two slots in it, so arranged that the knuckle lock of the signal lever, into which a pin is inserted, can be either kept locked or be released at the pleasure of the signalman at the station in advance. Electro-magnets are caused to act on a lever bar, which drops into a slot of the wheel and locks the signal-lever so that it cannot be moved to lower the signal. The bar is lifted out of the slot by a current, and only then can the lever be moved and the signal lowered. It shifts only to the danger position, where it is again locked. Mr. Spagnoletti further arranges, by means of an electro-magnet having a polarised armature in circuit with the line, that when the current is sent to lift the bar and release the signal the line wire is "broken," and therefore no second current can be sent to allow a following train to proceed until the previous one has arrived, and reset the apparatus which "makes" the line-wire again. And he arranges, moreover, that this re-setting apparatus is worked by the train itself, either mechanically or electrically. We need not concern ourselves with the mechanical arrangement; but as the present tendency of improvements in railway signalling is in the direction of automatic electric control by the train itself, it will be instructive to consider Mr. Spagnoletti's plan for this purpose. The re-setting is accomplished by means of a relay with two electro-magnets, one to draw an armature which is caught with a catch, and the other to release the catch holding the armature, and allow the line-wire to be "made" again. The current effecting this is sent by the train from a local battery. The closing of this local circuit is effected by the train, either by a metal brush projecting downwards from the bottom of the last carriage of the train, and making contact between two metal contact rods placed parallel and a trifle apart on the ground, or by a more elaborate but probably less serviceable apparatus, consisting of a friction roller, supported vertically under a metal plate, which is bent down by the arriving train upon the surface of the roller, and thereby completes a spring contact which sends the local current through the releasing relay. This friction device, however ingenious, will probably turn out in practice to be less suitable than the plain brush contact, partly owing to the jar and shock of the travelling train setting it out of order, and partly by reason of the expense and difficulty of insulating it from the weather. Mr. Spagnoletti proposes to "tie it up in an india rubber bag," or put it in a waterproof case; but all this requires time, trouble, and money, which might very well be spared by the simpler plan of the open brush contact. To be sure the friction of the brush on the iron rods or rail contacts will soon destroy a brush; but the assurance of action, provided the rods have not been tampered with, is sufficient compensation for the wear and tear of copper brushes.

Another of Mr. Spagnoletti's improvements is the use of a "train describer," whereby a signalman working the signals may know the character of the approaching train, whether fast or slow, goods or passenger. This, briefly described, consists of a dial with numbers on it, indicating the kind of train, and a pointer which is actuated by a clockwork escapement worked by electro-magnets. Each current sent by operating on the clockwork advances the pointer one division of the dial until the desired number is reached. The sending is performed by means of keys, or plungers, and the describer is reset on the arrival of the train by the signalman at the other end.

Mr. George Kift Winter's plan for working the block system on single lines has stood the test of lengthened use in India, where the traffic is so small that nearly all the lines are single tracks, and the rule of first come first served is applied to expedite the passage of trains. In India and the colonies it has a wide field before it, for there the lines are of great length, and the staff and ticket mode of working, or the crossing order, to which in this country the block system is an auxiliary, is altogether inapplicable.

This fact, however, only increases the responsibilities of the block system in these countries, and elevates it from a subsidiary position to the all-in-all; and it becomes necessary that the block instruments should not only show whether the section is "clear" or "blocked," but if blocked they should indicate whether the train is approaching or leaving the station; and there should be a permanent record of the fact that A has given "line clear" to B, or B has given "line clear" to A, as the case may be. For it may sometimes happen that a train at A is ready to start for B at the same time that a train at B is ready to start for A; and since one must wait for the other to pass, it ought to be clearly understood and recorded by the instrument itself which train may be allowed to start and which must wait.

The miniature semaphores of Mr. Preece are admitted to be excellent for double line working; but it is evident that they will not fully answer the requirements here. Having, however, the important feature of requiring the combined action of the signalmen at *both* ends of a section to remove the danger signal, they have been recommended for adoption on the single lines of India by Major Mallock, of the Government Telegraph Department, and have been in use for some little time on the Great Indian Peninsula, the Bombay, Baroda, and Central India, and other railways; but in each of these applications there is nothing to show which way the train is travelling. The most that is told is that there is a train on the section going one way or the other. The precise direction it is going in is left to the memory of the signal-

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men, or to an entry in the signal book, but every one knows from experience that the memory of signalmen is not to be trusted, and that entries in books may be erroneous. Mr. Winter's new instrument prevents the need of relying so far on an errant and delicate apparatus like the human brain, the very versatility of which unfits it for performing the unvarying and simple acts of a machine. Moreover, it is so contrived that neither signalman, alone, can alter in any way the indications of either instrument. Both signalmen must act conjointly in order to alter the indications of an instrument at either end of the section. It has been generally recognised that a signalman should not be able to alter the indication of his own instrument; but it is equally important that he should be unable to alter those of the distant instrument, without the cognisance and co-operation of the distant signalman. It is important, too, that no false current, due either to lightning or contact with another wire, should be able to alter any of the indications, and this is specially arranged for in Mr. Winter's indicators.

That inventor has discarded the minature semaphore device, and adopted the single needle. This indicator, which resembles the single needle telegraph instrument, has two dials, each having a single needle and pointer. One needle is painted red, and refers to the trains approaching the station; the other is painted black, and refer to trains leaving the station. Each needle has two positions—namely, the right, or "line cleared," and the left, or "on line." Underneath the red indicator are the printed words, "train coming from," and underneath the black indicator are the words, "train going to," while the name of the station with which the instrument is connected is printed between these legends, so as to serve for both and complete their sense. Each instrument is also provided with a plunger to give signals to the distant station, a bell on which the signals from the distant station may be received, and a switch handle, which, provided an acknowledgment arrives from the distant signaller, controls the "train coming" indicator of the near station, and the "train going" indicator of the distant one. No signal is considered complete until it has been acknowledged, and it is necessary that the signal itself should be followed by its acknowledgment before the instrument indicates the signal that has passed. Thus, suppose a train has to leave A for B, it is not enough that B should give line clear to A, but it is also necessary that A should acknowledge this signal before the instrument at A indicates that a train is "coming from A." So also, when the train arrives at B, the arrival signal must be given by B and acknowledged by A before the instruments indicate that the train has "cleared" the section.

These arrangements of Mr. Winter, if properly attended to, are evidently sufficient to prevent any accident by the block system. In India, however, the stationmasters are sometimes guilty of neglecting the block instrument altogether, and allowing a train to leave without previously obtaining "line clear" from the next station. So, to prevent this contingency, Mr Winter has introduced a starting semaphore outside of the signal cabin in view of the engine-driver, and worked in connection with the block instruments, in such a manner that it cannot be lowered to allow a train to leave until "line clear" has been received from the next station. It has further been considered advisable to cause the train itself when entering a station to set the semaphore to danger automatically. When at danger, it is held there either by an electric lock, which can be liberated by the line clear signal from the distant station, or by a counterpoise under the control of the signalman in charge of the semaphore.

Mr. Winter's system has been chiefly designed for single lines, but it is none the less applicable to double lines, and now that he is in England he will perhaps be able to adapt and introduce it upon some of our home railways.

THE ATLANTIC TELEGRAPH COMPANIES.

After going through the usual phases of enthusiasm, strife, and disappointment the French cable adventure has succumbed. The fact will surprise nobody, except perhaps the French subscribers, who, it appears, are now only too glad to come to terms with the English companies, whom they attempted to rival. In September last negotiations were entered into for bringing about working arrangements between the three companies, and it was to sanction these arrangements, which were completed provisionally by the end of November, that meetings were convened in Paris on the 13th inst., and in London on the day following, of all the parties concerned. Overwhelming majorities on both sides of the Channel approved of what the directors of the English companies, and M. Pouyer-Quertier, for the French company, had agreed upon, and the three cables will henceforward work on the joint-purse principle, the receipts to be apportioned in a manner which it may be hoped will be remunerative to all. The several agreements submitted to the meetings of the Anglo-American Company and the Direct United States Company respectively were those bearing dates and between parties as follow, viz.:—"(1.) An agreement dated the 24th September, 1880, and made between the Anglo-American Telegraph Company (Limited) and the Direct United States Cable Company (Limited) of the first part, and La Compagnie Française du Télégraphe de Paris à New York of the second part; (2.) a supplementary agreement dated the 24th September, 1880, and made between the Anglo-American Telegraph Company of the one part, and the Direct United States Cable Company (Limited) of the other part; (3.) a supplementary agreement dated 24th November, 1880, and made between the Anglo-American Telegraph Company (Limited) and the Direct United States Cable Company (Limited) of the first part, and La Compagnie Française du Télégraphe de Paris à New York of the second part." By these agreements the English companies were to take 84 per cent. of the receipts—63 per cent. for the Anglo, and 21 per cent. for the Direct Company, the French Company taking the remaining 16 per cent. In the case of the Direct United States Company a further agreement was ratified, dated 24th September, 1880, which had been entered into with the French Company, for the use of its repairing ship, "Pouyer-Quertier"—an arrangement which was considered highly desirable, seeing that the Direct Company possessed no repairing ship of their own.

We published a full account of each of these London meetings in a Special Edition last Saturday, but as many of our readers would necessarily be unable to see the reports we may here repeat a few of their more interesting features. It was stated that every pains had been taken to apprise the promoters that the new French cable would be a mistake, but that as the enterprise had been persevered with there remained no alternative but to put down the rates. The reduction resulted in a loss of some £200,000; but the stimulus given to telegraphing during that period of sharp competition would, it was hoped, partially compensate for the abatement of receipts to be handed over to the intruding company. At all events, since the adoption of the 2s. tariff on November 15th, a larger sum had been spent in telegraphing across the Atlantic than had been spent when the 3s. rate prevailed; and there was some ground for hoping that room would be found for the profitable working of all three companies. Continued competition would have been ruinous; and although amalgamation had been suggested, the joint working arrangement, by which the Anglo and the Direct companies gave over in equal proportions a percentage of their receipts, was thought to be preferable, as very little would be gained by unifying the management.

In the course of his remarks, Viscount Monck, the chairman of the Anglo-American Company, gave an emphatic contradiction to the statement put forward on the previous day by the *Daily News* that three of the companies' cables were in an indifferent condition. This was the exact opposite of the truth; and a denial was promptly sent to that newspaper, which, however, relegated the chairman's letter to an obscure corner and small type. Some very pointed references were also made to the newly-projected cable, or cables, under the auspices of Mr. Jay Gould. It was stated that the American Union Telegraph Company, of which that gentleman is president, has a binding agreement with the French Company that all the Atlantic business of the former should be transmitted

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by the cable of the latter; and it seems to follow that if the Jay Gould international cables be laid the Jay Gould inland telegraphs cannot send messages over them. This is rendered the more remarkable as a fusion is being brought about by him of the several American land line companies, all of whom have working agreements with one or other of the existing cable companies. On the whole the meetings were sceptical as to the likelihood of Mr. Jay Gould persevering in his threat of laying two fresh cables.

At the Direct United States Company's meeting Mr. Ford presided in the absence of the chairman, Mr. Pender, M.P., who was unfortunately absent through the death of his second son, an obituary notice of whom will be found in another column.

THE UNITED TELEPHONE COMPANY.

Disagreements having arisen among the directors of this company with reference to its management and the conduct of its negotiations with the Post Office, a general meeting of the shareholders was held on the 13th inst. at the Guildhall Tavern, London. It was also intended to discuss a proposal in reference to the formation of a "Provincial Telephone Company," but this had to be postponed owing to the protracted discussion on the question of management. The Right Hon. E. P. Bouverie, Viscount Anson, Mr. W. P. Bouverie, and Col. C. E. Webber were the dissentient directors, and it was stated that they intended to resign if their resolution declaring the management "unsatisfactory" was not carried. Notwithstanding this threat, and the severe criticisms which the other directors underwent, especially with respect to a certain agreement entered into with Messrs. Scott and Wolloston, an amendment expressing confidence in the management was carried by 54 votes against 13. In the course of the discussion it came out that Messrs. Scott and Wolloston, who had paid £700 for their privilege of acting as the Company's agent for the sale of telephones, were now being offered £50,000 by the Company to cancel the agreement. Colonel Webber himself, it was alleged, had involved the Company in great and useless expenditure by attempting to carry out vast schemes that were proved to be impracticable. Colonel Webber defended himself, as did also Mr. Gower, who warmly resented the accusations of piracy which had been freely made against him. He contended that he had in no sense evaded the terms of his agreement with the Company, and pointed out that he should very soon be able to demonstrate his usefulness by handing over something like £24,000 in the shape of royalty—which sum would not cost the Company a penny. Mr. Hubbard, of the American Telephone Company, took part in the discussion, and supported the majority on the board, although he was strongly of opinion that the practice of selling telephones, or allowing them to be sold, was highly injurious to the Company's interests. Mr. Hubbard assured the meeting that the Telephone Company in America had never sold an instrument, not even to the United States Government. The meeting (a lengthy report of which was published in our Special Edition last Saturday) lasted four hours, and was then adjourned for a fortnight.

THE CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED).

The nineteenth ordinary general meeting of this Company was held on the 19th instant, at the offices, Old Broad-street, under the presidency of Mr. T. Hughes, Q.C.

The SECRETARY (Mr. James Scott) read the notice convening the meeting, and the directors' report, which has appeared in *The Electrician*, was taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, said the shareholders would of course have seen, with the same regret as the board, that the past half year had been one of the worst, if not the worst, that the Company had experienced in the ten years of its existence, and from the documents which had been submitted to them, they would have no difficulty in accounting for this state of things. They would have seen that practically during the greater part of the year the majority of the sections of the West India and Panama Company's lines had not been working, and they were the best feeders of this Company, and the source upon which they almost relied for their traffic. When such a condition of things as that prevailed, the result must be prejudicial to the Company. He was happy to say, however, that towards the end of the year, by the exertions of the West India and Panama Company, their lines, with two exceptions, were now in working order, the result being at once apparent, because their private advices showed that the traffic was already to a considerable extent righting itself. He regretted, however, to say that the two sections which remained to be repaired of the West India Company's system were two of the most important—namely, the Demerara section and the Colon section, through the latter of which the traffic from the isthmus came to Europe. This section was of increasing importance at the present time, on account of the expedition which M. Lesseps was just about to despatch to the isthmus. He was, however, happy to say that the ship which the West India Company had despatched for the repair of this section was already well on its way, and he trusted within a very short time to hear that the cable had been repaired in time for the important traffic which would accrue as soon as the works at the isthmus commenced. The break down of so many lines of their allied company had been the main cause of the poor results in the six months. Of course, the shareholders would have seen that the effort which was about to be made when they last met to repair the Cienfuegos-Santiago section of this Company's original cable had failed. He had always told them that in his judgment the life of a cable in those seas could not confidently be reckoned on as more that ten years, and that opinion was to a certain extent being borne out by the condition in which the old cable of this section was found, and which was at least 100 miles in length. The repair of it would be exceedingly difficult, if not impossible, and supposing they were to repair it they would have to renew the whole of that 100 miles. Fortunately, however, the board had been able to make a more satisfactory arrangement, which he hoped would prove very beneficial to the Company. They had arranged with Messrs. Hooper for the purchase of a new cable to be laid from Cienfuegos to Santiago, and the vessel which was to take the cable out was intended to start that day. The weather might have prevented it from leaving Gravesend, and might make a delay of some days necessary. The reason why he spoke so hopefully of the future of this arrangement was that the purchase had been made by the Company at a net sum spread over twelve years. By this arrangement they would have to pay Messrs. Hooper for the cable and its maintenance the sum of £4,000 a-year. Taking the average expenses which the Company had been put to during the term of its existence in repairing the cable, the amount was over £5,000 a year, so the shareholders would see that this arrangement was likely to be an exceedingly beneficial one. The repairing expenses had been considerably heavier in the last three or four years than in the first five or six years, but he had given the average over the whole life of the Company. Under these circumstances, and taking into account that the sum of £4,000, which they would remember was carried over last half year to meet the cost of repairs, and which must be considered lost, practically, they would feel that it was desirable that the reserve fund should be maintained, and that they should carry the amount recommended in the report (£2,500) to its credit. When that had been done the balance remaining for division would allow of a dividend, free of income-tax, at the rate of 5 per cent. per annum. He felt that it was of the utmost importance to keep a good reserve fund, because although the proceedings at Panama might have a beneficial effect upon their cable, there was no doubt that it might lead to efforts on the part of others to supply telegraphic communication with the isthmus; and this Company ought to be in a position to take advantage of any alliances which might be offered in respect to any new combination, or to act themselves with the greatest promptitude and vigour. Nothing could help them to do this so well as the possession of a good reserve fund. These were the recommendations which the board made to the shareholders. With respect to the accounts, there was nothing in them out of the regular routine which need be referred to. The gross expenditure was much larger than usual, but the cause of that was that it included the sum of £3,379 for expenditure on the useless attempt which had been made to repair the old cable. He concluded by moving the resolution.

Mr. ALEXANDER F. LOW having seconded the motion,

Mr. STOKES expressed the satisfaction he felt at the nature of the contract which had been made with Messrs. Hooper for the laying and maintenance of a new cable.

Mr. GRIFFITH remarked that the board could not of course control what was going on at the bottom of the sea, and he hoped that they would have greater success in the future by means of the contract made with Messrs. Hooper. Referring to the numerous breakages which had happened to the old cable, he thought that it would be wiser to have an independent survey made of the new cable by some electrician well versed in the matter. He was glad to hear of the new contract, for it seemed to be on advantageous terms, and it must certainly remove a weight of anxiety from the minds of many of the shareholders when they were informed that the repairs in future were already provided for.

The CHAIRMAN, in reply, said as regarded having an independent opinion as to the condition of the cable the shareholders would see that the board had practically the best independent opinion which they could have. Messrs. Hooper would send out their own engineer, and when the vessel reached Cuba the Company's engineer would go on board and represent them during the whole of the laying. The Company's engineer had carefully examined the cable at the works and was thoroughly satisfied with its condition. With respect to the bottom of the sea in the latitudes where these cables lay, they had undoubtedly found that it was very rocky and an exceedingly hard bottom on which to lay a cable. They were, however, inclined to think that a great deal of the difficulty might be avoided by taking a new course, and they hoped that in laying the present cable the greater part, or at least a portion of the danger might be avoided. It had been suggested that there was some volcanic action there which was prejudicial to the cable, but so far as their experience went there was nothing to prove that such was the case, nor had they been troubled with the teredo. The great cause of the breakage had been the precipitous places over which the cables had been hitherto laid.

The resolution was then carried unanimously.

The CHAIRMAN next moved the payment on the 20th inst. of dividends at the rate of 5 per cent. per annum on the ordinary shares, tax free, and at the rate of 10 per cent. per annum on the preference shares, subject to income-tax.

Mr. STOKES seconded the motion, which was carried unanimously.

A vote of thanks to the chairman and directors terminated the proceedings.

THE FRENCH PARIS TO NEW YORK TELEGRAPH COMPANY.

(FROM A CORRESPONDENT.)

Memorandum of proceedings at meeting of shareholders of the French Paris to New York Telegraph Company, held in Paris on Wednesday, the 12th January, 1881. M. Pouyer-Quertier in the chair.

After two of the largest shareholders had been called to the table, and a

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secretary appointed, the chairman declared the meeting duly constituted. He explained that for the meeting convened for December there had not been enough shares lodged to constitute a quorum, but the statutes provided that in such a contingency the second meeting called should be an effective one, no matter how few shareholders attended. For the present meeting 24,000 shares had been deposited, and 16,642 shares were represented,

The report of the directors was then read. The full text of the agreements was next read, and the commissary's report was read by M. Dromery.

A resolution was next read formally approving of and ratifying the agreements.

M. le Comte DILLON next read a statement to the effect it was always his wish the Company should be worked in an independent and patriotic way, and he was always opposed to any arrangement with the English companies. The present proposition worked unfairly for them, for while the 21 per cent. would give to the Direct Company a return upon their £1,300,000, the 16 per cent. they were to get would have to be in respect of £1,680,000, so that the return on the Direct shares would be 300 as against 200 on the French shares. The arrangement was no doubt considered a favourable one by the English companies, because they had offered a considerable remuneration to the people who had brought it about; but he would let that pass. The directors' report contained no mention of a dividend, but merely the 16 per cent. To-day they were the only companies, but to-morrow M. Jay Gould would have taken the pains to establish the two lines which the French Company was started to do. If Jay Gould laid the two cables he would take 40 per cent. of the total traffic, which is stated at over £860,000, and a fight would begin by a man of energy who knew where he was going. M. Dillon here read the correspondence which had appeared in the newspapers between Jay Gould and Mr. Pender, and which showed Jay Gould's resolution to make the cables. Jay Gould had made an arrangement by which all his messages should be carried by the French Company's lines, but if he made these cables he would break his treaty with them. What would become of the French Company if deprived of the messages from the continent of America? While it was true that for three months the traffic was 13 per cent. they must not forget that the Anglo Company were working at 6d., whilst they were at 2s.; but when the rate was alike they went up to 20 per cent. In conclusion, he urged that Clause 15 of the agreement, giving the power of the boards to vary the accounts, should be modified [cries of "Monstrous!"]. He recalled the president's words in June last as to their independence, and what was true in June was true to-day. They ought to remain as they were and wait for better days. Now they were at the mercy of the English lines, and at times might have no other means of communication. Their line should remain French entirely, and in despite of all, and they could then show all adversaries they were ready to fight [cheers].

A SHAREHOLDER opposed the resolutions, and protested against the agreements. He held no one had a right to propose such an arrangement, and they should hold the president and members of the board personally responsible for their action, and also any shareholder who voted for it [laughter].

A second SHAREHOLDER approved of the agreement as giving better means to fight Jay Gould.

M. DROMERY, the Commissary, wished to avoid all personalities (referring to M. Dillon). Jay Gould was not a new thing to them, they knew of it for weeks, and had discussed it, and Dillon had been present at their deliberations. Jay Gould had a treaty with them which they had in their hands to transmit all his messages over their lines, and to-day he had the courage to say he would lay two cables! Did not their cable exist? Did not their treaty give them entire control? Jay Gould had signed the agreement binding him in the most formal manner to give them all the communications coming from his land lines in America. They had taken the engagement to transmit all their messages through his lines. They had done more, they had given him the communication with their land lines, and yet he states to-day he is going to lay two new cables, and will send his messages by them. Is this American justice? Do not talk of Jay Gould, it is not serious [murmurs]. The agreements now submitted were indispensable. Did they know how many days they had to live if they did not make them? In the month of June the situation was not what it is to-day.

Another SHAREHOLDER proposed a resolution stating it was impossible for shareholders united in general meeting to approve contracts which appeared to be opposed to the objects in the creation of the Company as evidenced by the statutes. The gist of his resolution was that by making the agreements the working arrangement assumed the form of a private partnership and not of a limited company.

The CHAIRMAN explained that the Company's legal adviser had especially advised on this point, and had, in fact, drawn the clause himself (M. Leon Renoux). He said the agreements before them would be submitted to the English companies. They had made no concession to the English, but the English had to them. The working administrations were completely independent, and they would be able to economise something like 20,000f. a year in general expenses. Take the ship; there would be large economy in that alone. With these economies and the 16 per cent. they would attain a good result. They had had three months' experience, and if they knew what their receipts were before, they would be sorry to revert to the position. Now they would receive a considerable sum on account of the traffic. Count Dillon spoke of 20 per cent.; yes, but that was when the Anglo-Brest cable was broken [loud cries of "Vote, vote"].

A SHAREHOLDER asked if their concession did not stipulate there should be no fusion or amalgamation, and that there should be no combination having for its object the pooling of receipts? Should they not obtain M. Cochery's consent first?

The CHAIRMAN replied that M. Cochery would not speak about the matter until the shareholders had adopted the agreement. He said come to me when the agreement was ratified; as a Minister he could not deal with it before.

A SHAREHOLDER pointed out that as there were two English companies and but one French company they would be in a minority, but the chairman explained it was the two English companies contracting on the one part and the French company of the other part, so there were virtually but two parties to the agreement.

The CHAIRMAN, in answer to a Shareholder, said the receipts would be sufficient to give 5 per cent., and that notwithstanding the reduction of tariff from 3s. to 2s. the receipts were more than the last year. The Company would have now a prosperous position, it will have no more trials, and have certain receipts.

A vote was called for, and a show of hands decided that the discussion was to be closed.

The polling showed 503 votes—466 for, 37 against.

Count Dillon left the room before the vote was taken.

THE EASTERN TELEGRAPH COMPANY (LIMITED).

Report of the directors to be submitted to the seventeenth half-yearly ordinary general meeting, 27th January. The directors submit the accounts and balance sheet for the six months ended 30th September, 1880. The Company's revenue for this period amounted to £268,128 15s. 5d., from which is deducted £68,039 12s. 4d. for the ordinary expenses of the Company. and £30,476 7s. 2d. for expenditure relating to repairs of cables during the half year, as shown in the annexed accounts, which, with £3,276 5s. 6d. for income-tax, leaves a balance of £166,336 10s. 5d. From this amount £43,081 2s. 4d., the interest on debentures and the dividend on the 6 per cent. preference shares to the 30th September, 1880, together with two interim dividends on the ordinary shares for the quarters ending 30th June and 30th September, 1880, amounting together to £137,906 2s. 4d., have been paid, leaving a balance of £28,430 8s. 1d. to be carried forward. The several sections of the Company's cables are in good working order, with the exception of the direct Lisbon cable, laid in 1870. This cable has been a source of great expense to the Company, owing to very frequent breakages caused by the great irregularity of the bottom of the ocean. In 1876 a break occurred in 2,000 fathoms water, and pending a favourable opportunity for effecting repairs at this depth, arrangements were made for an alternative land line through Portugal, connected by a short cable with Vigo. As, however, the land line and also the Company's duplicate cable between Vigo and Lisbon were interrupted every winter, endeavours were made last summer to restore the direct cable, and change the position of the Vigo Lisbon cable. Both of these operations were successfully accomplished. The directors regret, however, to report the breaking of the direct cable within three months after it was repaired; but as the interruption has occurred in a portion of the new cable so recently laid, no doubt is entertained of the restoration of the line by the Company's repairing ship "Chiltern" early next summer. The revenue above mentioned includes the dividends for the half year in respect of the Eastern and South African line, which is worked by this Company, and in which the Company hold nearly all the shares. The Eastern and South African Telegraph Company, after paying all working expenses, and charges for debenture interest and sinking fund, have paid a dividend of 9s. per share (£10) for the nine months ending 30th September last (the period since the line was opened for traffic), being at the rate of 6 per cent. per annum, placing £2,500 to a reserve fund for maintenance ship and hulk, and £25,000 to a general reserve and renewal fund, and carrying forward a balance of £5,124 0s. 7d. In accordance with the provisions of the articles of association, two of the directors, viz., John Pender, Esq., M.P., and the Baron d'Erlanger, retire by rotation. The former offers himself for re-election, but the Baron d'Erlanger's engagements and residence in Paris render him unwilling to continue to be a member of the board, and the directors do not think it necessary to fill up the vacancy thus occasioned. A resolution will be proposed to fix the minimum number of the ordinary directors at seven. The auditors, Mr. Henry Dever and Messrs. Quilter, Ball and Co., retire, and offer themselves for re-election.

TRAFFIC RECEIPTS FOR DECEMBER, 1880.

COMPANIES.	Dec., 1880.	Dec., 1879.	Inorse.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company.....	—	—	—	—
Cuba Submarine Company.....	2,300 estd.	3,317	—	1,017
Direct Spanish Telegraph Company	—	—	—	—
Direct United States Telegraph Company ...	—	—	—	—
Eastern Telegraph Company	48,776	45,704	3,072	—
Eastern Extension Telegraph Company	28,010	26,025	1,985	—
Great Northern Telegraph Company	16,800	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company..	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company.	—	—	—	—

QUINTUPLE TELEGRAPHY.—Experiments have been successfully made between Boston and New York in sending five messages simultaneously on one wire.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—After the President's address, to be delivered on the 26th inst., Mr. Heaviside will read a paper on "Telephony and Induction."

THE ELECTRIC RAILWAY.—The correspondent of the *Daily News* who some days ago announced that Dr. Siemens' electric railway would be open in a few days, now states that it will not be opened to the public until the end of March or beginning of April at the earliest.

CONGRESS AND THE TELEGRAPH.—In the United States Senate, December 14th, Mr. Morrill, of Vermont, offered a resolution instructing the Committee on Post Offices and Post Roads to inquire whether or not the existing telegraph lines largely interfere with the business of the Post Office Department, and whether telegraphic service should not be placed in the hands of the general Government, which was adopted.—*Journal of the Telegraph.*

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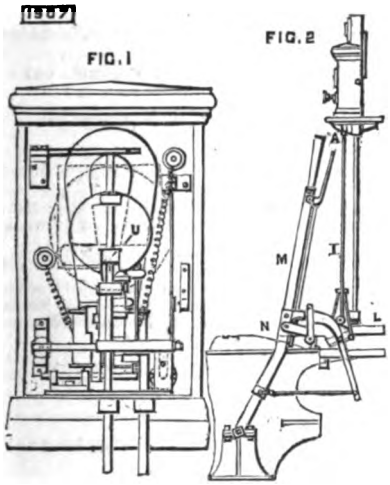
ABSTRACTS OF SPECIFICATIONS.

1907. IMPROVEMENTS IN RAILWAY SIGNAL APPARATUS.—*By William Robert Sykes.*—(*Dated 10th May*, 1880.) 6d.

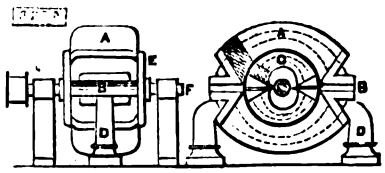
This invention consists of improvements in railway signal apparatus, and has reference more particularly to improved mechanical and electrical arrangements for carrying out the combined lock and block system of signalling or working signals. In a previous specification, in explaining the operation or working of the system at three given stations, or signalling points, called A, B, and C, the inventor described that the lock at A was released by the back motion of the starting lever at B, and afterwards remarked that this might be done by the forward motion of the lever at B. In practice he finds that the latter is generally to be preferred, and in carrying it out he now gives the signal "clear" on an indicator at A by motion from a plunger at B, which plunger takes the place of the spring and collar described in his former specification. When the plunger has been acted upon to give the signal "clear" at A, as mentioned, it cannot be acted upon again until the starting lever at B, which has been locked in its normal position, has



been released by C. The starting lever at B when in its other position, that is, when pulled over and the signal is down, is locked, and it may be released either by a treadle in advance of the signal, as described, or by a plunger called the platform plunger under the control of the station staff at B (an arrangement which will be found particularly advantageous in foggy weather, when the train cannot be seen by the signalman); also, when the starting lever at B is pulled over and the signal is down, the plunger which releases A is locked until the train has passed over the treadle in advance of the starting signal, or until the platform plunger has been used. Thus the signalman at B cannot give "clear" to A until B has given the train on to C, and C has released B's starting lever, which B must pull over and again put back after it has been released by the treadle or platform plunger, as above described. The back motion of B's starting lever, brings two springs into contact, which then send a reverse current to the arm galvanometer at A, thus indicating to the signalman at A that the section of the line between A and B is "clear" (but not unlocking the lever at A), and that he can ask the signalman at B to accept another train, which the latter can do by any suitable means, such as a bell worked electrically, or a telephone. No other block instruments are required, because in these arrangements not only is the arm galvanometer a block instrument in itself, but also the indicator is both a block and locking instrument, Fig. 1, containing the upper lock. Fig. 2 shows case and lever. Words to show condition of line are painted on two metal strips, and can be shown. The upper strip is actuated by magnets, the armatures of which are controlled at the advance station, and connected through the blade A. This blade is jointed to the rod I, which is attached to a crossbar litting a sliding piece which forms the lock, out of and into a notch cut in a tappet, L, attached to a signal lever as shown. L is attached to the lever M by a stud, N, and the action of the combined mechanism can be seen from the figure. The lower slip is carried by another blade held by a click resting on a pin on a blade. The click is pushed off the pin by a plunger and angle piece. The blade U is actuated by the motion of the lever.

2272. IMPROVEMENTS IN OBTAINING, INCREASING, AND EMPLOYING ELECTRICAL CURRENTS. *Thomas Slater.* (*Dated 3rd June*, 1880). 6d.

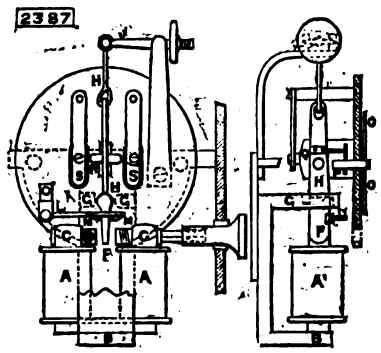
The machine devised has a modified Gramme ring, more completely encircled than in some other machines. A A are the fixed electro-magnets, having their like poles opposed and separated by a strip, B, of non-magnetic material. Each magnet surrounds one half the circumference of the revolving armature C, and the poles are each brought to a line where opposed to the revolving armature. The form of the core of these magnets is clearly shown in the drawings, the wire being wound thereon in the direction of the axis of



the revolving armature. These fixed magnets are supported by pillars, D, or by any other suitable means. The revolving armature C is in like manner composed of two similar electro-magnets, with their like poles opposed and separated by a strip of non-magnetic material. The wire is wound on in the direction of the axis, as in the fixed magnets. On the ends of the ring are fixed two plates, E, and these carry the shaft F for imparting rotary motion to the ar mature. The shaft F is supported in bearings, and carries a driving pulley.

2387. IMPROVEMENTS IN ELECTRIC TELEGRAPHS AND IN APPARATUS CONNECTED THEREWITH. *By Sir C. T. Bright.*—*Dated* 12th *June*, 1880. *Price* 6d.

This invention consists of improvements in the receiving part of electric telegraph instruments. Fig. 1 shows the back of the dial of the improved instrument, Fig. 2 a side elevation of same partly in section, the letters agreeing in both figures where corresponding parts are shown. Two electro magnetic coils are fixed to the lower pole of a permanent magnet (the middle of which is indicated by dotted lines), by which they are polarised; C C^1 are the upper poles of the coils, and the soft iron pole pieces D D^1 pass though the poles, into which they are screwed, and their distance from each other can be regulated by means of adjusting keys applied to the brass square ends. The adjustment by this means is very delicate, and the polarisation is very perfect, owing to the intimate contact ef the screw threads throughout the surfaces. An opening in the outer case of the instrument opposite to the square ends enables any adjustment to be made by the keys without removing the case, as shown, by a key passing through a hole in the side of the case, which is represented in section. The free end of a movable soft iron armature or tongue is polarised by G G^1, the upper pole of the magnet B G, and has therefore an opposite polarity to that of the poles D D^1, between which it lies. The other end of the tongue is supported upon pivots in a slot cut in the pole of the magnet. A lever of aluminium for the sake of lightness, is extended from the axis of the tongue on the upper side of and in the same plane with it. The length of the lever is greater than that of the tongue, so that the application of force at its end has through its greater distance from the axis or fulcrum a leverage or mechanical advantage over the end of the tongue at the point where it is opposite the poles. The end of the lever is connected by a link of aluminium or other metal (or which may be a thread or



a piece of fine gut line, such as is used by anglers) to the end of a small movable lever or arm, which is mounted on centres, as shown, and carries an adjustable weight. By the action of the weight through I upon the lever the latter is retained in its place of rest or zero when no current is passing. A spring may be used in place of the weighted arm, but it is not so steady in its action upon the indicating needle described below. A light pivotted arm resting upon two pins, standing out from a small plate fixed upon the tongue near to its axis, checks any vibration of the tongue and lever at the end of a beat or signal. At a point in a line with the lever, about a third part of the distance between its axis and end, a light axle is pivotted in the same plane as the axis of the tongue, one end of which passes through the dial plate, and carries a light external indicating pointer or needle, and the other end inside the dial carries a short arm, which is slotted or forked at its upper end, and is engaged by a pin projecting from the lever. At another point in the lever about as far from its fulcrum as the length of the tongue the hammer is fixed. Two sounders, S S^1, are fixed by means of steel plates and studs to the back of the dial plate, and the sounders serve as stops to limit the motion of the hammer and lever and of the needle outside the dial.

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THE EASTERN TELEGRAPH COMPANY (Limited).

REPORT OF THE DIRECTORS,

To be presented to the SEVENTEENTH HALF-YEARLY ORDINARY GENERAL MEETING, 27th JANUARY, 1881.

NOTICE is hereby given that the Seventeenth Half-Yearly Ordinary General Meeting of the Eastern Telegraph Company (Limited), will be held on THURSDAY, the 27th January instant, at TWO o'clock in the afternoon, at the City Terminus Hotel, Cannon-street, London, to receive the Directors' Report and Accounts; to elect Directors and Auditors, and transact the ordinary business of the Company.

By order of the Board,

GEORGE DRAPER, Secretary.

London, 18th January, 1881.

BOROUGH OF SWANSEA.

ELECTRIC LIGHT.

The Town Council of the Borough of Swansea are prepared to receive TENDERS for the illumination by ELECTRIC LIGHT of High-street, Castle-street, and Wind-street in the said Borough.

Plans, showing the gradients and widths of the said streets, and other particulars can be obtained on application to Mr. T. P. MARTIN, Foreman of Work's Office, Somerset Place, Swansea.

Tenders (in sealed envelopes, marked "Tender for Electric Lighting") to be sent to me on or before the 1st day of FEBRUARY next.

JNO. THOMAS,
Town Clerk.

The Guildhall, Swansea, 14th January, 1881.

A SOUND COMPANY or FIRM requiring FIRST-CLASS OFFICE ACCOMMODATION in the City, may meet with the same, combined with professional assistance and commercial representation by an experienced Engineer with a fair connection. Terms very moderate; unexceptional references.—Address, X., care of Housekeeper, Palmerston-buildings, E.C.

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NOTICE OF REMOVAL.

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FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

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SLIP

South America.—Telegraphic communication is now restored between Bahia and Rio de Janeiro.

The Hebrides.—Telegrahpic communication with the Hebrides, which had ceased for upwards of a week, was restored a few days ago.

New York.—Snow storms in New York and neighbourhood last Saturday destroyed all telegraphic communication with that city for some days.

Hoosac Tunnel.—Experiments have determined that the attempt to light the Hoosac tunnel by electricity is successful only when the tunnel is clear of smoke.

Fire Alarms.—MM. Fagot and Pascal Barbier have devised a new form of electric fire alarm on the principle of electrical contact being made by heat expansion.

Atlantic Cables.—It is now generally acknowledged that since Jay Gould has come to terms with the rival company in America, the Atlantic Cable scheme will not be carried out.

Electric Light at Lyons.—The Paris-Lyon-Méditerranée Railway Company have decided to dispense with gas in this station and adopt the electric light.—*La Lumière Eléctrique.*

The Physical Society of France.—At the last meeting of this society the President, M. Mascart, stated that M. D'Almeida had bequeathed to the society two manuscripts of Ampère on electro-dynamics.

Underground Telegraphy in France.—*La Lumière Eléctrique* states that the Minister of Posts and Telegraphs has under his consideration a scheme for replacing the existing aërial lines by underground cables.

Maxim Light.—The United States Electric Light Company has purchased the large building at Avenue B and Seventeenth-street, New York City, intending to use it as a manufactory of the Maxim lamps and other electric apparatus. This will be the largest shop in the world devoted to such purposes.

City and Guilds of London Institute.—We notice that a placard setting forth the subjects of examination and other particulars with regard to the scheme for the advancement of technical education has been circulated widely by the above institute, so as to place the subject well before the working classes.

Direct Spanish Cable.—Recently Falmouth was put into direct communication with Bilbao and Madrid by the wires of the Direct Spanish Cable Company (Limited). This will be a great boon to those wishing to communicate with Spain, South America, &c., direct, and should also benefit trade between Falmouth and Spain.

London Fire Telegraphs.—Captain Shaw states in his report for the past year that the electric fire alarm system has conveyed nearly as many false calls as good calls. One offender, caught tampering with a fire post, was sentenced to fourteen days' hard labour; and this, Captain Shaw remarks, has had a satisfactory deterring effect.

Prices.—The prices of gutta percha as quoted are:—For genuine 6d. to 3s. per lb., for reboiled 2d. to 1s. per lb. India rubber, per lb.:—For Para (fine) 3s. 5½d., Negrohead 2s. 4d. to 2s. 5d., Central American 1s. 9d. to 2s. 5d., Assam and Pegu 1d. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 4d., Madagascar and Mozambique 1s. 8d. to 2s. 4d.

A Thermo-Electric Telephone.—M. F. Krœtlinger has devised a new form of telephone, the current for which is supplied by a thermo-electric pile. The variation is obtained by causing the voice to fall upon the flame which supplies heat to one of the elements. The results are said to be encouraging, and are certainly curious, though the articulation is far from perfect. Further experiment is suggested.

The Paris International Electical Exhibition and Congress.—The Emperor of Germany, the Government of the Netherlands, of Italy, and of Belgium respectively have given in their official adhesion. *La Lumière Eléctrique* is informed that the United States Government will probably vote a sum of money in proof of its goodwill. The same authority is sure that the co-operation of England may be counted upon. We hope it may, but we see no signs of it at present.

Male Telegraph Learners.—An open competition for thirty-six vacancies, being the number estimated as likely to occur within the next six months, will be held in London on Monday, February 28, 1881. The limits of age are fourteen and eighteen. Candidates must be of the prescribed age on the day of examination. The examination will be in the following subjects—viz., (1) writing from dictation, (2) handwriting, (3) arithmetic (easy sums in the first four rules).

New Electrical Property of Selenium.—M. Blondlot has presented to the French Academy of Science a note on what he considers to be a hitherto unnoticed property of this interesting metal. To one of the poles of a capillary electrometer he connected a piece of annealed selenium by means of a platinum wire; to the other pole he connected a plate of platinum. On bringing the two metals in contact the electrometer remained at zero; but on their being rubbed together a marked deviation was observed. M. Blondlot thinks that the effect is not thermo-electric, as the current is in the opposite direction to that which would be set up by heat.—*La Lumière Eléctrique.*

Electric Paper.—It is well known that ordinary letter paper if rubbed acquires electric properties. M. Wideman, however, has found that if one takes Swedish filter paper, or this paper laid between pieces of letter paper, and subject it to the following treatment, it displays strong electric properties, and sparks several centimetres long can be obtained. The paper should be plunged into a mixture of nitric acid and sulphuric acid of equal volume. The paper thus pyroxilised is then washed in plenty of water and dried. Then rub quickly, having stretched it on a waxed cloth, in order to give it electric properties. Nearly every experiment with static electricity can be accomplished with the paper.

The Electric Railway at Berlin.—Owing to the severe weather prevailing for a fortnight past the works upon the Berlin Electric Line have been much retarded, and cannot be resumed until a thaw sets in. The carriages of the Electric Railway will convey twenty passengers each. There will be seats for twelve, and standing room for the remaining eight. The dynamo-electric machine will be placed between the axle-trees and the floor of each carriage. The rate of travelling will be greater than that usual on tramways, and is expected to reach about twenty miles an hour. Powerful brakes, combined with an arrangement acting on the electrical apparatus, will enable the official in charge to bring the carriage to an almost instantaneous standstill.

The Telephone in India.—The Government Telegraph Department in Calcutta appear to be following the lead of the Postmaster-General in this country. In November last they obtained a sample supply of some thirty of the loud-

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speaking telephones of the Gower-Bell Company for experimental trials, and we understand that the results have given so much satisfaction that the company has now received by telegraph a substantial order for a large number of its instruments. If this may be taken in conjunction with the recently-announced refusal of the Government of India to sanction the setting up of Telephonic Exchanges on the part of private speculators it would seem to indicate a resolve on the part of the executive to itself supply the Indian public with what will soon be found to be an indispensable aid to the business and pleasure of life in India.

Quintuple Telegraphy. — Chicago, December 30th. *The Times'* Boston special says:—"The Western Union Telegraph Company has for six weeks been experimenting between this city and New York with a new invention whereby five messages may be simultaneously sent from each end of the line, and so far, it is said, the contrivance has proved satisfactory. The principle involved is that which underlies Professor Elisha Gray's telephone, that by vibrations of tuning forks, tones of different pitch can be sent over the wire simultaneously and separated at the receiving end by ingenious contrivances. A vibratory tuning fork at the receiving end is made to break the circuit so as to deliver a message in the Morse alphabet. The Western Union Telegraph Company is said to have offered the inventor 150,000 dollars if he shall succeed in using one wire for four simultaneous messages, and 25,000 dollars for each time a message is superimposed after that. As stated above, six weeks of trial are successfully past, and it is stated that on the 21st instant five operators in New York and five in Boston, using one wire, sent and received twenty-one hundred and thirty messages, or forty per hour for each man."

Ocean Depths.—The companies engaged in the laying of submarine cables have rendered the science of navigation a service by the information they have supplied in respect to the configuration of the beds of several seas and oceans. The Telegraph Construction and Maintenance Company has placed at the disposal of the Admiralty more than 550 deep sea soundings, to be incorporated in the official charts. They refer to ocean depths along important routes between Ireland and Newfoundland, in the Red Sea, along the entire length of the East Coast of Africa, between Java and Port Darwin, and between Hong Kong and Manilla. Some of the depths extend to 2,350 fathoms. The India Rubber, Gutta Percha, and Telegraph Works Company has contributed soundings in the Bay of Biscay, by which the 100 fathoms edge of the bank, extending from the French shores to the 46th parallel of latitude, has been further delineated. The Eastern Telegraph Company has also supplied information of the same class. When it is remembered that over 1,000 Admiralty plates of charts require correction or addition in a year, and that nearly two hundred thousand copies are printed, it is difficult to say how much value may be attached to even one new sounding.—*Architect.*

Telegraph Clerks' Grievances in Parliament.—Mr. J. Cowen asked the Postmaster-General if it was correct that the officials at various post offices were endeavouring to prevent the telegraph clerks from making their grievances known to the public; if the officials at Sheffield and Cardiff had threatened to suspend anyone taking part in calling meetings of clerks; and if orders had been given to destroy any correspondence addressed to the staff?—Mr. Fawcett: I believe it is just possible that, in order to prevent the agitation among the telegraphists passing beyond legitimate bounds, in some instances undue restraints may have been put on their methods of making their grievances known. I am not aware of these instances, but if my hon. friend will direct attention to them they shall at once receive my consideration. So far as the general subject is concerned, I think it will be seen from the public press that these have received a wide publicity. In regard to the two towns specially referred to in the question, I have made inquiries since the question appeared on the paper, and I have received the most positive assurance that no such threats have been used, nor has it been intimated by them that correspondence addressed to the staff should be destroyed. I can only say that the complaints of the telegraphists are receiving the most careful consideration, and no effort will be spared to have a conclusion arrived at with the least possible delay on the subject.

Poetry and Science.—In looking through the back volumes of the *Society of Arts Journal* in connection with our recent notice of telegraphic archæology we have noted a letter, signed Henry W. Reveley, in which the author refers to Spenser's "Fairy Queen" to find "a splendid description of two of our great modern discoveries." He says:—"In the sixth canto of the second book, the screw steamer is imaginatively brought to a very high perfection; and in the forty-sixth, an equally beautiful description of the electric light." Consulting Spenser's works (edition printed for J. and R. Tonson and S. Draper, MDCCL.) we find that the second book has no forty-sixth canto. Our late friend Mr. Reveley passed away at a ripe old age some years since, so that he cannot give a nearer indication to the lines referred to. The reference to the screw steamer is probably the following (Book II., Canto VI.):—

Eftsoons her shallow ship away did glide,
More swift than swallow sheres the liquid sky,
Withouten oar or pilot it to guide
Or winged canvas with the wind to fly;
Only she turn'd a pin, and by and by
It cut away upon the yielding wave,
Ne cared she her course for to apply;
For, it was taught the way which she would have,
And both from rocks and flats itself could wisely save.

Can any reader give another reference to the electric light than that in Book II., Canto IX., ver. 46, which probably are the lines referred to by Mr. Reveley?

The roof hereof was arched overhead,
And deck'd with flowers and herbars daintily,
Two goodly beacons, set in watches' stead,
Therein gave light, and flam'd continually;
For they of living fire more subtilly
Were made, and set in silver sockets bright,
Cover'd with lids devis'd of substance sly,
That readily they shut and open might.
O, who can tell the praises of that maker's might!

Mr. Edison's Melancholy.—From a New York contemporary we extract the following lamentation, forming part of a long soliloquy purporting to have been delivered by the disappointed inventor. Like most soliloquies, it is probably imaginary; but coming from the immediate neighbourhood of Menlo Park it is not without its moral, nevertheless:—"I'm getting tired of this business anyway. My part of the work is almost done. It will be done just as soon as the new engine gets in place and the public exhibition is made. I don't care so much for the money, but I think I ought to have credit for what I have accomplished. Only a year ago the subdivision of the current for lights was declared a practical impossibility, and scientists and electricians avowed that my carbon filaments would not last two hours! Everybody was down on me. And now a fellow named Swan is making an exhibition in London with my incandescent lamps, and claims to have done all that I

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have done twenty years ago. And, to cap the climax, Spottiswoode, the president of the Royal Society, announces to the world that Swan has at last solved the problem of the electric light! What's the use of a man trying to do anything anyway? He gets no credit. If he keeps things secret and won't tell everything, he is denounced as a mountebank; and if he does things openly they steal all his ideas. It's hard to make an exhibition on the square to satisfy everybody, and in electrical matters it's the easiest thing in the world to make a big splurge not on the square. And the crooked fellows, too, stand the best chance of getting capital to back them. The next thing I get up I'm going to advertise a reward of 10,000 dollars, stating publicly all I expect to accomplish, and telling the man who can prove that he has already done what I expect to do to step up and take the money, or forever after hold his peace. Talk of the patience of Job! He's got a mighty big pile of credit on a comparatively small amount of capital. When I began work I found that it would take 480,000,000 dollars to lay the wire for the best electric light then known. And yet I have not done anything. I'm going to get out of this business just as quick as I can."

THE INDIAN POST OFFICE AND TELEGRAPH.—An Indian journal, comparing the Postal and Telegraph Departments, points out that while the post offices and letter boxes have increased in number by 170 per cent. during the last ten years, the number of telegraph offices has only increased by 34 per cent. during eleven years. Now, without raising the question whether telegraph extensions might have been wider, and the public offered greater facilities than the Department at present offers, there can, says the *Englishman*, be no doubt that the progress of telegraph business and extensions has been very great, far greater than our contemporary seems to suppose, for he appears to have made the error of regarding only what are called departmental offices, the fact being that the whole of the State railway, and some of the guaranteed railway, wires are in the hands of the Department, and the same is true of all the State railway offices, including the East Indian Railway system. As a matter of fact, as the State railway lines and offices have been brought into existence, many of the departmental offices have been closed as no longer necessary, the Department having control of railway offices at these stations. The extension of the telegraph system, like that of the postal system, is an evidence of the development of the country. What that progress has been during the last ten years will be seen from the following figures:—The mileage of line in 1870-71 was 15,326, while in 1879-80 it was 20,530, an increase of 34 per cent. But this does not nearly represent the increase of carrying capacity, for the wire was 28,949 miles in 1870-71, whereas in 1879-80 it was 51,192, an increase of 130 per cent. 6,700 miles of this wire were maintained on railway lines under departmental management. Add the introduction of duplex telegraphy, and it will be seen the carrying capacity of the wires has increased as well as their mileage. In 1870-1 the number of departmental offices was 190, in 1879-80 there were 250 departmental, and 525 railway, or a total of 775. The Department really managed 300 per cent. more offices, most of which are new State railway offices, which have rendered so-called departmental offices unnecessary, or, in some cases, actually superseded them, the departmental office being closed in favour of the railway. In the same period the revenue has increased by 142 per cent., and the number of paid messages by 148 per cent. There can be no doubt that a business increasing at this rate must prove as great a success financially as can be wished, and at no distant date. We can understand the Government wishing to keep out those who would break through its monopoly, but we trust the Department will prove itself equal to advancing with its financial success in the direction of showing that, so far as the public are concerned, the stimulus of competition is unnecessary.—*Homeward Mail.*

OVERHEAD TELEGRAPH WIRES.—On this question, which we have so often discussed, Dr. Siemens writes the following letter to *The Times* of Jan. 20:—"Sir: Among the causes of danger and inconvenience which the snowstorm of yesterday has created none will be felt more keenly by the public than the partial interruption of telegraphic communication throughout the country, and it may be interesting to inquire whether such occasional interruption of telegraphic traffic is a necessary evil connected with this great achievement of recent times, or is attributable to preventable causes. It would not be difficult to prove that such interruptions are entirely preventable by a reconstruction of our telegraphic system in a more permanent manner. This would involve considerable expenditure, it is true, but an expenditure that would very soon recoup itself, through a greatly reduced cost of maintenance. There would be immunity, moreover, from those causes of interruption, great and small, which constitute a daily source of trouble to the operator, and which upon such occasions as yesterday throw us suddenly back to the conditions of the pre-telegraphic age. By the substitution of underground for suspended line wires the causes of uncertainty attaching still to the land telegraphic system of the day would be entirely removed, together with the danger and unsightliness inseparable from tall wooden poles, strained to the utmost by their load of suspended wires, placed along our railways and public thoroughfares. Proof is not wanting in favour of an underground system of land telegraphy. When, in the year 1846, the Prussian Government decided upon the construction of electric telegraphs it adopted an underground system which did not prove practically successful, owing to a want of experience in insulating the conductors and in protecting them against the attacks of animals and of gradual decay. The German Government, nothing daunted by the comparative failure of these early experiments, decided five years ago to resort again to the underground system for the principal lines of communication throughout the country. So complete has been their success that, after having laid down some 8,000 miles of underground insulated wire, they have resolved upon a considerable further extension. The plan adopted in Germany consists in enclosing seven or more separately insulated conductors within a core of moist hemp, surrounded by a complete sheath of iron wire, which, again, is covered with a layer of hemp yarn, impregnated with a protecting compound. These land cables are wound upon drums at the sheathing works, and after being subjected to careful electrical tests are paid out into trenches three feet deep, and covered up. I may state, I think, without fear of contradiction, that on these 8,000 miles of underground wires, part of which have now been down for five years, no expenditure for maintenance has been incurred, and, judging by the perfect condition of the cables, it is not likely that any repair will be required for many years to come. Taking this immunity from decay and also from wear and tear into account, I am convinced that the underground system is not only the most perfect, but will also prove to be the cheapest in the end, and an occurrence like that of yesterday furnishes perhaps a fitting opportunity of calling, through your courtesy, public attention to this important matter."

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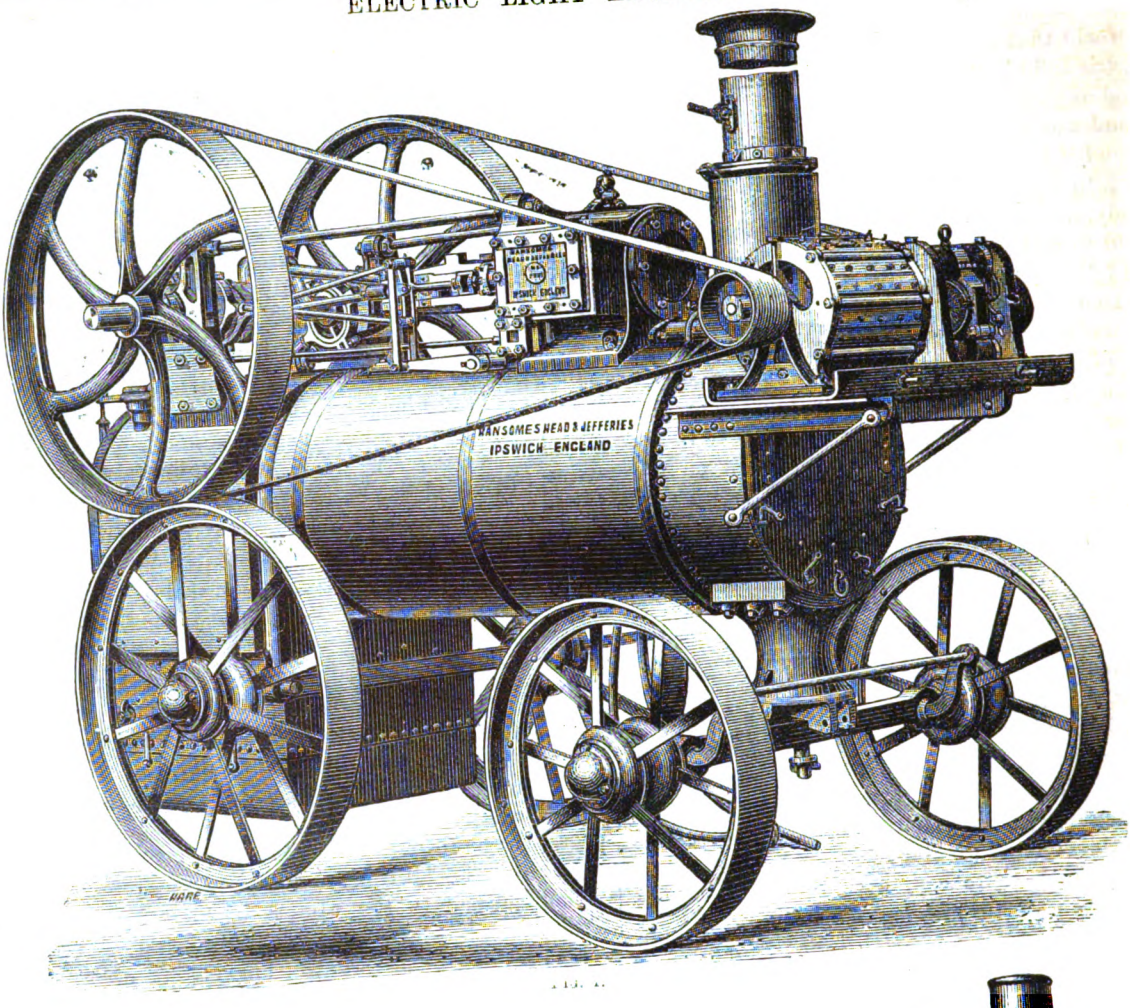
ELECTRIC LIGHT ENGINES.



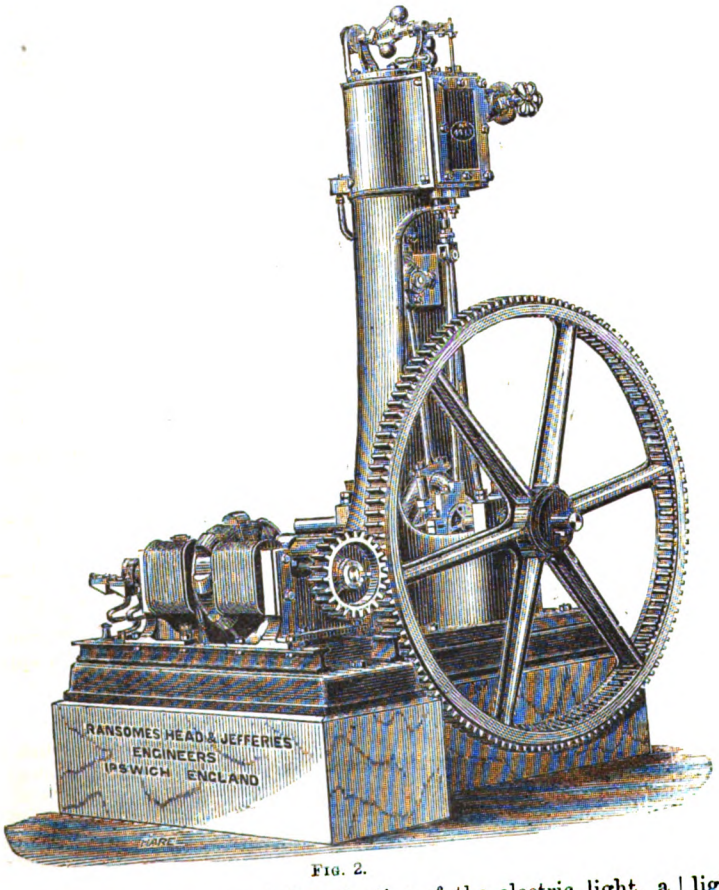


FIG. 2.

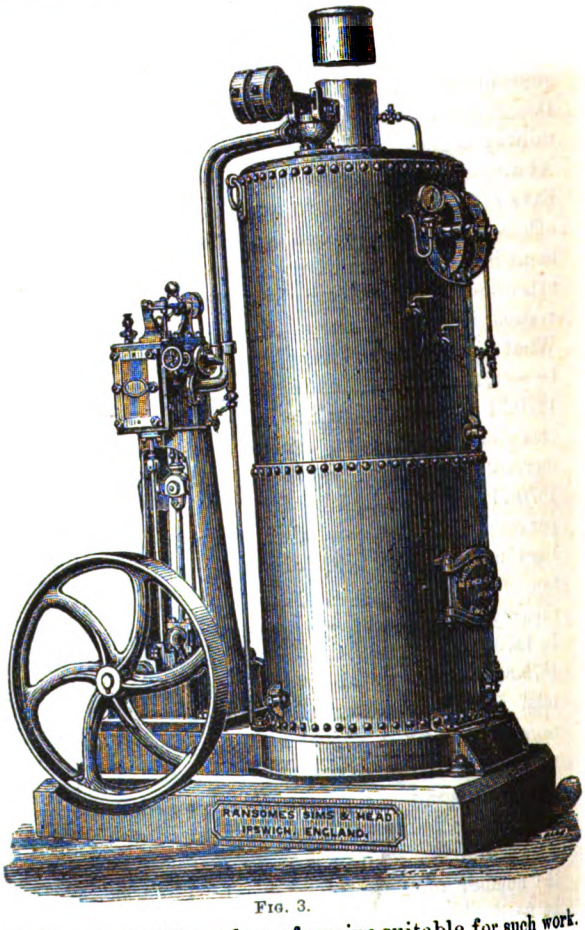


FIG. 3.

Since the more general introduction of the electric light, a special demand has been made on the constructors of electric light engines to provide a class of engine suitable for such work. It must be remembered that these engines are required to run

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steadily for hours together, thus entailing a strain upon the working parts of the engine, which, with perhaps the exception of marine engines, no class of engines had been called upon previously to undergo. The builders of engines have, according to the experience of electric light engineers, complied fully with the demands made upon them. As we mentioned last week Messrs. Ransomes, Sims, and Jefferies have just issued an illustrated catalogue, descriptive of their make of electric light engines; and by their favour we are now able to illustrate some types of this special make of engines. Fig. 1 shows a portable engine, with a special arrangement for carrying the electric machine. The engine is constructed with a fire box of ample capacity for burning wood as well as coal. Engines of this type are strongly recommended for all contract or temporary work. Fig. 2 shows a vertical engine fitted with a spur fly-wheel, so as to use gearing instead of a strap for driving the electric machine. This arrangement saves space, and avoids the annoyance caused by the stretching or slipping of straps, also ensuring almost perfect regularity in the speed of the dynamo machine. Fig. 3 illustrates a simple verticle boiler and engine on one foundation plate. The engine can be had without the boiler. Such engines require but little space, and are inexpensive to repair or fix, so that they are useful for small electric works, and in places where great economy in space is an object.

PHYSICAL SOCIETY.—JAN. 22.

NOTES ON THE CONSTRUCTION OF THE PHOTOPHONE.

A paper on this subject by Professor SYLVANUS THOMPSON was read by Professor Rheinold. Professor Thompson was led by experiment to question whether Professor Bell's form of photophone receiver was adapted to give the best results. Theoretically, he finds with a given maximum of incident, light distributed uniformly over the surface of the change of resistance in a selenium receiver will vary proportionally with its linear dimensions, provided its parts be arranged so that, on whatever scale constructed, the normal resistance shall remain the same. A cell n times greater linearly each way will produce n times the variation in resistance for the same total amount of light. This follows from Professor W. G. Adams's law that the change in the resistance of selenium is directly as the square root of the illuminating power. The author also finds that, if the thickness of the conducting discs in the enlarged cell be kept the same as before, and their number increased n times, the change of resistance will be n^2 times as great as before. Selenium cells should therefore be as large as possible, and the light should be distributed over them uniformly, not focussed to a point. A conical mirror would therefore be better than a parabolic one to receive the beam. Such a reflector would be cheaper to construct, and there would be a minimum of loss by reflection, as the light would fall perpendicularly on a cylindrical cell parallel to its axis. To give the best effect its angular semi-aperture should be 45°, and this will bring the front end of the cell in the same plane as the mouth of the reflector. Professor Thompson has also constructed an improved cell by winding parallel wires on a cylinder of slate grooved with a double-threaded screw, and filling the interval between them with selenium. This form gives superior effects to Professor Bell's disc device.—Mr. SHELLFORD BIDWELL said that long annealing improved the sensitiveness of selenium for photophonic purposes. He got the best speech from cells of high total resistance made with fine wire. The selenium should, however, have a low specific resistance. With the apparatus he showed at a recent meeting of the society he could now transmit articles from *Nature* and the *Nineteenth Century* so as to be heard every word by the listener.—Professor GUTHRIE suggested that amorphous phosphorus should be tried in place of selenium, as a more permanent substance.

MEASURING RESISTANCE AND CAPACITY.

Mr. GLAZEBROOK, of the Cavendish Laboratory, Cambridge, read a paper on the measurement of small resistances, and the comparison of the capacities of two condensers. In measuring small resistances by the Wheatstone balance the results differed on varying the resistance in the battery wires. According to Professor Crystal, this was due to a thermo-electric effect produced at the middle point of the divided platinum-iridium wire when the contact is made with it. It could be avoided by making this contact first, and then making the battery contact. Mr. Glazebrook investigated the effect mathematically and experimentally. He suggested that the resistance in the battery wire should be kept small in comparison with the other resistances, and then the effect was inappreciable. It could also be eliminated by taking two measurements with reversed currents and calculating out. The author next considered the effect of a small leakage in comparing condensers in the Wheatstone balence method. Dr. Hopkinson stated that he had found a modification of this plan to be very promising. For the battery he uses an induction coil, and for the galvanometer a telephone. Thus a high electromotive force and sensibility was obtained.

LEGAL.

On January 22, in the High Court of Justice, Chancery Division, the case of the Edison Telephone Company of London (Limited) came before the Master of the Rolls.

The company was formed in August, 1879, to purchase certain patent rights from Mr. Edison and to acquire and work those patents. By their memorandum the company had power to sell any portion of their business in such manner as the company should think fit, and by the articles of association Mr. Edison was to have in respect of one share, to be allotted to him according to his agreement, one-half of the aggregate votes in the company, and the articles further ratified and adopted the agreement with Mr. Edison. According to his original agreement with the company, the company were to pay Mr. Edison a royalty during the continuance of the patents or a share of profits at his option. The agreement was subsequently modified, and Mr. Edison was by the modified agreement to be entitled to one-half of the dividends after £5 per cent. had been paid to the shareholders. It appears that the company have recently, by an agreement of the 13th of January, 1880, sold their business to a new company called the United Telephone Company (Limited), in consideration of 23,000 fully paid-up shares in the latter company, and the Edison Company have since altogether ceased to carry on their business, and they are bound by their agreement with the other company not to carry it on. Except Mr. Edison's claims under the agreement all the liabilities of the Edison Company have been discharged. A petition was now presented by the shareholders for a compulsory winding-up order, on the ground that a voluntary winding-up would not be carried through owing to Mr. Edison's voting power.

Mr. MILLER, Q.C., and Mr. RENSHAW, for Mr. Edison, objected to any winding-up order being made, on the ground that if the company discontinued their business it would be a breach of their agreement with him, which they had by such agreement impliedly agreed to continue.

The MASTER of the ROLLS said, in his opinion, it was a clear case for a compulsory order. The company had been formed for the purpose, if he might so call it, of carrying on a telephonic business, but by their memorandum the company were also entitled to sell their business. Mr. Edison had made an agreement with the company which had been ratified by them by which he was entitled to be paid for his patents out of the dividends of the company, and according to the articles of association the term dividends was defined, and they were to be payable only out of the profits arising out of their carrying on the business. What Mr. Edison alleged was that the company had impliedly agreed with him to carry on the business and so enable him to be paid out of the profits. That contention had, however, no bearing on the present case, because the company were expressly empowered to sell their business, and the mode of preventing any injustice to Mr. Edison by that course had evidently been by giving Mr. Edison his preponderance of voting power. The company had now sold their business out and out, and had taken as the consideration certain shares in another company, which shares they could no doubt sell as part of their assets. The company would not, therefore, earn any further dividends, and there was nothing left to do except to divide the proceeds of the sale among the shareholders. Mr. Edison might, of course, have a claim upon these assets, but, in his opinion, he had no right to prevent him from making a winding-up order, which he should accordingly make. As his opinion was so clear, he must also refuse to stay the winding-up, pending an appeal by Mr. Edison.

FAST TELEGRAPHY DURING THE STORM.—Notwithstanding the unprecedented length and severity of the storm, telegraphic communication with the large centres has been well maintained, and in some instances at a high speed. For example, one day last week more than 2,000 messages passed over a single wire between London and the north of England in nine hours, a fact which, considering the state of the weather and the exceptional length of telegrams in this country, has probably never been equalled in any other.

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THE AGGRIEVED TELEGRAPH CLERKS.

We have been favoured, like others of our contemporaries, with a statement of the grievances which postal telegraph clerks are now publicly complaining of; and as we take an interest in the welfare of telegraph *employés* all over the world, we feel bound to notice the agitation now on foot amongst that section of them employed by the Post Office in this country.

The document in question is heavily weighted with detail, and the pith of the matter is not easy to get at. But probably this is a fault common to all organisations comprehending a multitude of persons differently circumstanced and of various grades, claiming every one to have his grievance set forth as a condition of his adhesion to the movement. By the light of the reports of their public meetings, however, we think we can see what it is that has stirred the postal telegraph clerks to a state of acute agitation just now. Briefly, it is the fact that the finances of the postal telegraph administration have at length struggled to a position of solvency. Not long ago the Postmaster-General, speaking encouragingly to a deputation on the subject of reducing the tariff, remarked that, looking at it from one point of view, the telegraph account might now be considered as showing a handsome balance on the right side. He was probably not aware that some four thousand or five thousand claimants eager to pounce upon the first available balance were, so to speak, already assembling outside his door. What is sauce for the Society of Arts is sauce for the Society of Telegraphists; and when a master incautiously magnifies his profits in these days his servants are apt to take him at his word.

When we say that the incident just referred to was the occasion for the opening of grievances we do not, of course, mean that it was the cause. The cause, indeed, was a long way off and behind. The staff of the old Telegraph Companies was transferred almost in a body to the Post Office, and after an experience of ten years of the new service the parties most concerned are extremely dissatisfied. Deprived of its padding, the memorial is essentially one from the senior body of clerks. The proposal for a class of boy clerks is one which the Department would be wise to consider; but except that the enlisting of the junior body is dictated by expediency, or possibly by a praiseworthy desire to raise the whole tone of the service, the juniors might, for the purposes of this memorial, just as well have been left out of account altogether. If beginners are to have 16s. a week instead of 12s. it is obvious that higher qualifications will be expected of them. Higher qualifications could certainly be got at that figure; but the case for them would have been stronger if it had been shown that the existing junior body, which by this time must be very numerous, is inferior to that which preceded it—in other words, to what the petitioners were when they were boys. This is the supply and demand view of the case. But it is modified by at least one very important consideration, namely, that technical knowledge, once little needed and never demanded, is now in some sort always desirable, and in many circumstances indispensable. The complainants shrewdly point out that, whereas in other occupations the introduction of new machinery diminishes labour, in this every improvement necessitates the exercise of greater skill and attention. This view of the facts would seem to point to a general levelling upwards of the status of the modern telegraph clerk. The contention of the clerks themselves is that the tendency is rather downwards. After all, the question is a Departmental one, and the efficiency of the service in this respect will turn very much upon which is to prevail, the extravagant claims of the public on the one hand, or their not altogether unreasonable complaints on the other. If a cheap tariff is to be the order of the day, the public will probably have to put up with its nastiness for many a day to come, and all hope of improving the status of the telegraph clerk in this country may be abandoned indefinitely. We have never sympathised with the busybodies who periodically agitate for sixpenny telegrams. Taking into account its wealth and its area, the United Kingdom is as cheaply served as any country in the world, and, in most ways, far more efficiently. If it is a question as between telegraph clerks and telegraph reformers, we have no hesitation in awarding the surplus profit, if there is any, to the clerks.

For, coming now to what we have assumed to be the gist of their case, we do think that the senior grade of telegraph clerks have good reason to be disappointed. Disappointment alone, however, would not go for much. Many persons expected great things when they became Civil servants; some few, we fancy, got what they expected; the majority certainly did not; but it by no means follows that they have been wronged. Wronged they have been, however, if the figures before us can be trusted. Taking into account the added years of service, the openings which telegraphic enterprise abroad would have afforded, to say nothing of the increased amount of labour exacted in the new service, the emoluments appear to be not only disappointing but inadequate, and the prospects still worse. Nor need there be much difficulty in granting all that the complainants demand. The difference between what they are and what they would be under the Playfair

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scheme, while it is great enough to be a substantial boon to the clerks, is not so great as to be terribly alarming to a prosperous administration; and such of the staff as can reasonably claim to be embraced by that scheme ought to experience no hostility to their pretensions.

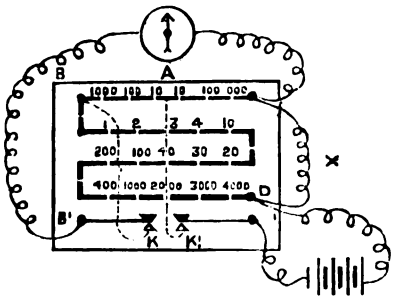
The clerks themselves take broader ground, and argue that, under the Act of Parliament relating to their transfer to the Crown, they are designated and promised the position of clerks and officers of the Civil Service, whereas by degrees they have not only lost their designation but also the privileges attached to it. To put it plainly, instead of being amalgamated, as they calculated on being, with the Post Office clerks as one body, the Telegraph is maintained as a wholly separate branch and its staff ranked as "telegraphists." We can very well understand how galling the process must have been that gradually subordinated this once exclusive profession to the control of a highly respectable but purely clerical body, who, though sure to be envied, were unable to inspire respect. Rightly or wrongly, the telegraph clerk fancies he is being "differentiated" into a sort of superior artizan. This is perhaps an exaggeration. But it seems to us that some such change as that which he deprecates was clearly inevitable from the very first; and no sensible man ought to quarrel with his nominal position if only he is substantially bettered by it. Seeing that the varied duties in a miscellaneous public department must of necessity be descriptively classified, there is nothing degrading in the term "telegraphist" so long as it is not made the excuse for his being ranked lower than the grade of clerk. The public would certainly be surprised to learn that he is not expected to be a clerk. As a fact he is a clerk, and none the less a clerk because he is something else as well.

It would follow from all this that if a special class has been invented for the members of the telegraph service, and their grade rendered thereby inferior to that of Civil Service clerks all round, a really serious wrong has been perpetrated. It has not been done designedly—that is to say, with a set purpose of evading the original bargain by which the clerks were induced to enter the service of the Crown. Economy may have had a good deal to do with it, the ignorance of the clerks themselves a good deal more; but whatever the explanation the fact seems to be established. It is no answer to say that the appeal comes very late. Young men are not blessed with the foresight of age, and that they did not consult their lawyers ten years ago is no argument against their doing so now, when they have realised the position they have drifted into. Moreover, they are probably like creditors in general, and have had no fancy for dunning empty purses. Their past forbearance has in no way cancelled their just claims; and, now that he has fallen in with good times, we hope the Postmaster-General may see the propriety of rectifying the error under which his telegraph clerks have suffered so long. Upon the details of their proposals we may offer some remarks on another occasion.

LESSONS FOR LEARNERS.

(CONTINUED FROM PAGE 104.)

The arrangement of resistance coils that I have shown you is one largely used in the submarine telegraph offices, and differs slightly from that known as the Post Office pattern. Here is a box of the latter pattern. Two keys, K K′, are provided, the former connected by a wire with the terminal B, the latter similarly connected with A, so that connecting the galvanometer at B′ is the same as connecting it with B; likewise the battery can be connected at A′ instead of A. One obvious advantage of this arrangement is that all your connections may be joined up and glanced at to see if right before depressing the keys to let the current pass. The resistance coils in the box are not necessarily the same as those shown; you can have higher or



lower resistances as required. The two strips (at the end of the parallels) are not connected by a coil below, so that if the plug joining them is removed a practically infinite resistance is introduced, and no current passes.

It is customary to call the continuity of substances which connect the battery plates, both inside and outside of the battery, the "circuit," and the depression of the keys K K′ is spoken of as completing the circuit. This custom is rather a straining of language, for the "circuit" is always complete, although air spaces breaking the continuity of the metallic conductor make the resistance too great to obtain a current. After this remark, however, we may follow the usual plan, and speak of putting this resistance into, or taking that resistance out of, the "circuit."

We will now see how the resistance coils are used. I have here a piece of wire, and we have to find its resistance. Perhaps Smith will be good enough to come and join up the apparatus for me.

You see he takes a piece of thick wire and joins one terminal of the galvanometer with the terminal B′; then he joins the other terminal of the galvanometer by means of a similar piece of wire to C. The battery terminals he joins to A′ and D, and he joins the piece of wire whose resistance is to be found to C and D. That is so far right. We will take out the 100 ohm plugs from the arms A B′, A C, and thus obtain equality of ratios. I have reason to think that the resistance of the wire is between 3,000 and 5,000 ohms, and as our aim is to so arrange the resistances in the arms that there shall be no deflection of the galvanometer needle, I will first take out the 4,000 ohms plug in B D. Now we are ready. The other plugs are all tight. I depress the battery key K′, keeping it down; I now momentarily depress the galvanometer key, and you see the needle moves. We allow it to come to rest. We know now that the 4,000 ohms is not the equivalent resistance to x. I now take out another 500 ohms, and, again first depressing the battery key, I make another momentary contact with the galvanometer key, and the needle again moves, but in the opposite direction to that in which it moved before. Our resistance is now too high. I put in the 500 ohms and take out 250 ohms, and depress the keys as before—first K′, then K; the very slight motion of the needle shows us that our work is almost done. I now try 251 ohms, and the needle shows no sign of motion: thus I find the hitherto unknown resistance x to be 4,251 ohms.

You ask me why I made those momentary contacts with the galvanometer key. My reason is this, the galvanometer I have used is rather a delicate instrument, and objects to rough handling. You know you may squeeze an egg, holding it longitudinally, between your hands or your knees, with a pretty considerable force, and it will not break, while a slight tap with a hammer will spoil its shape. Too large a current through this galvanometer might render it useless, so I take a little precaution to make the action take as short a time as possible till I have pretty well ascertained what strength of current is going through the instrument.

One more experiment, which need last only a few minutes, and then I shall leave you to ascertain by yourselves the resistances of the wires in this box. Each wire is numbered, and you will write on a sheet of paper the number opposite the resistance found, which you can give me at our next lesson.

Here is a coil of wire, which I insert in C D. I take the ratios of the arms A C : A B = 100 : 10, and find I must take out 3,425 ohms in B D to obtain a balance. In this case the unknown resistance

$$x = \frac{cb}{a}, \text{ when } c = 100,\ a = 10,\ b = 3{,}425 = \frac{3425 \times 100}{10} = 34{,}250.$$

(TO BE CONTINUED.)

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THE ROYAL INSTITUTION.

On the 21st January the first Friday evening meeting of the year 1881 was held, when Mr. Warren de la Rue, F.R.S., gave an admirable lecture on his experiments with over 14,400 cells of the chloride of silver battery. Notwithstanding the inclement nature of the weather the audience was large and enthusiastic. We are unable to do more than give its general groundwork and trust — as we have reason to believe it will — the lecture may be printed, with the illustrations of the apparatus, &c., shown and described. The lecturer said: "For the last six years I have, in conjunction with my friend Dr. Hugo Müller, been engaged with experiments on the electric discharge, using as the source of electricity a constant voltaic battery which we devised. It is in principle the same as that invented by Daniell, but in our battery a solid electrolyte, insoluble in water or a weak saline solution, namely chloride of silver, replaces the soluble sulphate of copper, so that no porous cell is needed in the chloride of silver battery. The results of our experiments my colleagues think of sufficient interest to be brought under the notice of the members of the Royal Institution, and I will endeavour to make them as clear as possible in the limited time at our disposal. I must, however, ask your kind indulgence if I fail, as I have not the practice of lecturing. It is true that it is not the first time that I have had the honour to occupy this chair, which I did upwards of forty years ago."

He then proceeded to describe the battery in detail, and among other things stated that the electromotive force of each cell was 1·03 volt. The cells are arranged in trays containing twenty and upwards, these trays being placed in suitable cabinets, holding 1,200 large or 2,160 small elements. The work of previous experimenters was referred to, and it was stated that in 1808 Davy, with 2,000 cells, obtained a spark of from $\frac{1}{40}$ to $\frac{1}{30}$ inch; while Gassiot, in 1875, with 3,000 Leclanché cells, obtained a spark 0·025 inch, while 3,000 of the chloride of silver cells gave a spark of 0·0564 inch, on account of better insulation. The current of 10 cells was passed through a voltameter, and a projection of the apparatus at work thrown on the screen. The action of stored-up electricity was shown by a condenser being charged and then discharged through wire. The current necessary to charge the condenser would decompose only $\frac{1}{5000}$ gramme of water, but the discharge showed the enormous mechanical effect this quantity of electricity might be made to wield.

A number of interesting experiments with condensers and wire were made, and then the strata in a tube containing CO_2 was shown as resembling water drops, though the forces producing the strata and water drops were quite distinct. The electric arc next claimed attention, photographs being projected on the screen, while it was stated that the length of arc at atmospheric pressure varies with the potential and the form of terminals, being between points as the square of the number of cells. 1,000 cells give 0·0051 inch, 11,000 cells give 0·62 inch. Except in the case of platinum the nature of the metal seems to have no effect on the length of the spark discharge from points. The law of discharge between various surfaces was considered, the increment of potential necessary to produce a spark the centimetre long being less as the distance between the terminals increases. The discharge between discs in different gases at a constant pressure, at varying distances, and with a varying number of cells, or at constant distance, and varying pressure and number of cells may be represented by a hyperbolic curve, the obstacle to the discharge being as the number of molecules between the terminals. After describing the streamer discharge and various phenomena connected therewith, reference was made to the grand natural phenomenon of lightning, in which a thunder cloud was considered as a mere point. A lightning flash 1 mile long could be produced by 243 batteries, similar to the one under discussion, which would contain 3,500,000 elements. Faraday proved that the quantity of electricity necessary to produce a powerful flash of lightning would be equivalent to that required to decompose a single grain of water. This might be realised when it was remembered that it would be 5,000 times as great as the charge in the condenser previously mentioned, and that the potential of 3,500,000 cells is one thousand times greater than that of the battery used to charge that condenser. Passing onwards to the discharge by cascade, it was remarked that Garton Planté's rheostat of 25 plates with 1,200 cells gives a spark 1 inch long; while 1,200 cells alone give but 0·00608 inch. So that the rheostat increases the length of spark about 164 times. The latter portion of the lecture dealt with the work which may be looked upon as a speciality of these experimenters. The Royal Society's *Proceedings* contain illustrated papers on the questions of the electrical discharge through tubes of varying character. A good account of these and other experiments will also be found in Vol. II. of Mr. Gordon's *Physical Treatise*. We shall therefore continue simply to indicate the course of the lecture.

The resistance of a gas diminishes with the pressure up to a certain point—as, for instance, in the case of hydrogen up to 0·642mm.; it then rapidly increases as the exhaustion proceeds, and at 0·00065mm., 8·6 millionths, it requires as high a potential as at 21·7mm., 28,553 millionths. At 0·00137mm., 1·8millionth, 11,000 cells could not produce a discharge in a tube for which 430 cells sufficed at the pressure of minimum resistance 0·642mm., 845 millionths. At a pressure of 0·0055mm., 0·066 millionth, the highest exhaust the experimenters have obtained, a 1 inch spark from an induction coil failed to pass. Under no circumstances has air been found to conduct, whether attenuated or dense; the discharge is a disruptive one. Further on came reference to the aurora, the maximum display of which occurs at an altitude of about 38 miles. The following table illustrates the remarks made here:—

Pressure mm.	Pressure M.	Height miles.	Visible at miles.	Remarks.
0·00000001	0·00001	124·15	1061	No discharge could occur.
0·000055	0·066	81·47	860	Pale and faint.
0·379	499·0	37·67	585	Maximum brilliancy.
0·800	1053·0	33·96	555	Pale salmon.
1·000	1316·0	32·87	546	Salmon coloured.
1·500	1974·0	30·86	529	,, ,,
3·000	3947·0	27·42	499	Carmine.
20·660	27184·0	17·86	403	,,
62·000	81579·0	12·42	336	,,
118·700	156184·0	11·58	324	Full read.

It is conceivable that the aurora may occur at times at an altitude of a few thousand feet.

The audience were then favoured with numerous experiments showing the striæ in tubes, the modifications undergone by such striæ under various conditions, the facts being made known that the discharge in a vacuum tube, however steady the striæ may seem, being pulsating, and the origin of the strata being at the positive pole, the resistance in a vacuum tube is not as in wires in the ratio of the distance from a terminal. At the conclusion of the lecture the author stated that the preparations which were necessary in order that this lecture could be given have occupied a considerable time. "In the first place it was not possible to remove the battery from my laboratory, as its construction would not permit it. I therefore have had built up an entirely new series in such a way that the battery can be carried away without injury. The construction of the battery was commenced in June, 1879, and was finished in August, 1880. The charging of the battery occupied a fortnight, and was finished in the second week of December."

THE SOCIETY OF TELEGRAPH ENGINEERS.

On the evening of Wednesday, 26th instant, the chair of this society was formally resigned by Mr. W. H. Preece into the hands of Professor G. C. Forster, the newly elected president. In acknowledging the vote of thanks of the meeting for his services during the past year, Mr. Preece was gratified to be able to announce that not only did he hand over to his successor a satisfactory financial balance, but also a balance of interesting papers which would be read during the forthcoming session.

Professor Forster then read his inaugural address, and commenced by remarking upon the fact of his election just at that point in the society's history when its title had been enlarged so as to embrace the Electrician as well as the Telegraph Engineer. Putting a natural construction upon this coincidence, and applying it to his own personal qualifications for the position he had been invited to occupy, he thought he could best illustrate the intention of the society by taking a survey of the past history of pure and applied science relating to electricity, and show how each had usefully reacted upon the other to the advantage of both. It had been said that practical inventions always spring out of scientific discoveries, but it was not less true that science was encouraged and greatly assisted by its practical application. The practical man supplied the scientists with fresh tools, so to speak, wherewith to pursue his investigations—a notable instance of which had been recently furnished in the construction of the telephone. Answers were also demanded of the scientist to questions which the practical man continually came across, and which would long remain unanswered, but for the necessity of an explanation for practical purposes. As an illustration of this fact we might contrast the electrical machine with the voltaic cell. Practically little or nothing was accurately known of the measurement of current from the former, while that from the

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latter had been calculated with the utmost nicety, the reason being that the one was of great practical use, while the other was of comparatively little. Professor Forster then passed in review the progress of electrical discovery during the last sixty years covering the periods of Oersted's needle, the electric arc, induced currents, and electro-magnetism. These were the outcomes of pure science, and it was not until about thirty years ago that their practical application began to be developed, and simultaneously the need for absolute electrical measurements. These had been worked out already by Ohm and by Weber as matters of merely scientific interest, but with such exactness that their results were to this day accepted as authoritative. They contributed greatly to the possibilities of practical telegraph from that date, and in the hands of Sir Wm. Thomson were instrumental in gaining for this country a foremost place in telegraphic enterprise. On the other hand, a little later, science was indebted in 1861 to the practical electricians for the adoption of an electrical standard of resistance which had proved a valuable adjunct to scientific investigation. Some standard coils, devised by a committee composed of Sir Charles Bright and others at that period, had been tested in 1867, and again in 1876 without any very marked change being observable except in one of them; but exactness had nevertheless not yet been attained, and the absolute value of the ohm had yet to be determined. Turning from measurements, the president next dwelt upon the value of exact methods of comparison, illustrating this part of the subject by descriptions of the uses to which Wheatstone Bridge and the Poggendorff methods had been put. Science had also to be thankful for the more homely but very useful service which practical men had conferred by their fertility in adding to our scientific vocabulary; Volts, Webers, and the like were phrases of practical growth, and such words as shunt were as handy to the scientist as to the working engineer who coins them. The paper concluded with some suggestions for combining pure and applied electrical science as a practical work for the society.

A vote of thanks couched in appreciative and appropriate terms was proposed by Mr. GRAVES and seconded by Professor HUGHES.

Mr. HEAVISIDE's paper on "Education" was then read by the Secretary, but we are compelled to withhold our report of it until next week.

ROYAL UNITED SERVICE INSTITUTION.

Mr. R. E. Crompton on Wednesday last lectured to the members of this Institution on "Recent Progress in the Electric Light." Mr. Crompton commenced by stating that the year 1880 will be looked back to as a year of great progress in the introduction of the electric light. He pointed out that at the commencement of the year there had been a repulsion in public feeling because of Mr. Edison's failure to perform the promises a Wall-street clique had made in his name. The subject was divided into two parts, one dealing with the machines, the other with the lamps. Previous, however, to describing the machines, the lecturer pointed out the utility of a trustworthy system of electric lighting for naval and military purposes. He then proceeded to briefly review the machines at present before the public, dubbing M. Gramme "the father of electric lighting," because he in his ring armature had given us the means of producing cheap electricity. The Siemens and Bürgin machines are modifications of the Gramme, but the Brush differs somewhat from the Gramme type, and claims are made that because of these departures it is superior to its rivals. The lecturer disputed these conclusions. There was, too, an emphatic condemnation of alternate current machines as dangerous and not economical. The engines used for driving the dynamo machines differ according to conditions. On board ship a fast speed engine, such as Brotherhood's or Gwynne's, generally drives two dynamo machines, whilst on land it is usual to drive by means of belting.

It is thus seen that we are supplied with handy machines for our work. It was strongly urged that the electric light was not a new light in principle. All lights are obtained from bodies raised to a high temperature. The utility of the electric light is that we can get the light where it is wanted. Not only can it be had at the source of combustion, but it can, so to speak, be telegraphed along the cable to the point of greatest convenience. The incandescent electric light is obtained by the insertion of a large resistance in the circuit. This, according to well known laws, is heated, and, if the temperature is high enough, radiates light. The incandescent lamps of Swan were shown in action, and described as having brought the electric light within the domain of household wants. The lecturer referred also to the work of Edison, Maxim, St. Lane Fox, &c., in this direction, and to André, Regnier, Werdermann, &c., in the direction of semi-incandescent forms of lamp. It was stated that the light obtained from the incandescent system was far inferior in quantity and in whiteness to that obtained from the arc, and at present the best arc systems were more economical than the best incandescent systems. The arc, however, is not yet adapted for use in comparatively small and confined areas, but more suited for large areas and open spaces. The difficulties in the construction of a good arc lamp were discussed, and the effects of imperfection shown by the action of the Serrin lamp. One of Mr. Crompton's own lamps hanging from the ceiling of the theatre was lighted up and showed the vast superiority of the arc system over the incandescent lamps for the same h.-p. used. The great difficulties in the way of a good arc system are in the moving the carbons in exact accordance with the consumption and providing for making contact when required. The Siemens, Brush, and Brockie lamps have fixed lower carbons and movable upper carbons; the Siemens and Brush are regulated by the light current itself, the Brockie by a separate current, while Mr. Crompton's lamp has both carbons movable, and the regulating parts are extraordinarily light—hence are actuated by a very slight change in the current. A good deal of the success of the electric light depends upon the carbons, which, if bad, no lamp can remedy.

Some very interesting information was given by the lecturer relating to that portion of the electric light capable of easily penetrating fog or smoke. Glasgow has recently been troubled with thick continuous fogs, so that day and night have been much alike. A goodly number of Mr. Crompton's lamps are in use in Glasgow, and experiments have tended to show that the rays that have the greatest fog penetrating effect are those that come from the crater of the positive carbon, only a few of the rays from the extreme top of the cone of the negative carbon possessing this characteristic. The results of these experiments indicate that in the use of the electric light for naval purposes, such as showing the position of an attacking torpedo launch, the light should be placed at a good height, and the rays not radiated in parallel lines by means of a holophote. The look out man should be below the light instead of above it. An 80 weber current should give command of a circle 200 yards in diameter even in a thick fog. Brief mention was made as to the cost of the electric light, and it was stated that during the past year the cost had been diminished one half—the lamp which twelve months ago cost 1s. 4½d. an hour being now produced and worked at the cost of 7d. an hour.

The lecturer, by request, concluded his lecture with a description of Professor Bell's photophone.

The President then invited discussion, the principal speakers being Mr. Spottiswoode, F.R.S., and Mr. St. Lane Fox.

The engine used to drive the dynamo machine was a new one, differing somewhat in type from previously made engines. The governor was extra large, and instead of a heavy fly wheel, two pulley wheels, one on each side of the engine are used. These wheels are such as have been hitherto used on 14-h.p. engines, but are placed on this 10-h.p. engine, which has been specially constructed for Mr. Crompton.

EASTERN TELEGRAPH COMPANY (LIMITED).

The seventeenth half-yearly ordinary general meeting of this Company was held at the City Terminus Hotel, on the 27th inst., under the presidency of Mr. John Pender, M.P.

The SECRETARY (Mr. George Draper) read the notice convening the meeting and the minutes of the last general meeting, which were approved by the present meeting, and signed by the Chairman as correct.

The CHAIRMAN then moved the adoption of the report and accounts, and recapitulated the particulars contained therein as to the financial results of the half year's working to the 30th of September last, as given last week in our abstract of the report. The net revenue showed an increase of £39,033, the traffic receipts having yielded an increase in the past half year of £27,548 to £256,246. The ordinary expenses showed an increase of £7,501, which looked large on the face of it, but a reference to the different accounts of which it was composed would show that the main item of increase was in maintenance and renewal of land lines, instruments, and electrical appliances, amounting to £4,423. The reason for this was that they were now replacing the whole of their Egyptian land lines with iron instead of wooden poles. The expense would probably not continue for more than another year, and would save a considerable outlay in the future maintenance charges. In the past half year's accounts there were also several exceptional items. There was a loss on the realisation of Egyptian Government debt of £772. The long-outstanding debt to the Company of the late Khedive, when settled, amounted to over £17,000, and scrip was handed to them in part payment to the extent of £11,880. They hoped to recoup the small loss mentioned by the enhanced value of this scrip, which at present formed part of the reserve fund, such was their confidence in it; and thus what appeared at one time a bad piece of business would terminate very fortunately for them. The interest charges in the past half year amounted to £340, against a credit of £233 in the corresponding period of 1879. That was the amount they had had to pay on advances pending the completion of the purchase of £390,000 in Eastern and South African Telegraph Company's shares, against which, as was shown in the accounts, they had received a dividend of 6 per cent. Foreign agencies showed an increase of £112. A further increase of £1,200 to £3,200 was also accounted for in maintenance ships reserve fund. The extraordinary expenses amounted to £30,476, showing an increase of

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£11,335, the details of which were shown in the published accounts under abstract C, which he read. They would see that the expenses of repairing cables, necessitating the employment of large steamships, was no joke. The working of the smaller vessel, the "Retriever," in effecting repairs had been in this respect most satisfactory; and he might state that she had pretty nearly paid for herself by the saving she had effected. He could give them all the particulars if they desired that he should do so, but he wished to draw their attention in particular to one item as having caused a large expense for repairs in the half year—he referred to the picking up of their Direct Lisbon cable at a depth of 2,000 fathoms, after it had been in the sea for ten years. That, he stated, was a matter which had occasioned considerable discussion and interest at the Board, as it had solved a most important problem, and had given a great increase to the value of the whole of their property, as they now felt that there was no question as to the picking up and repairing of any cable which was at a depth of any number of fathoms under 2,000. The work had been most successfully done, but at a cost of £20,000, which, however, was a very small per centage compared with the amount of their capital, and the enormous increase it had given to the whole of their system. Unfortunately it had broken again, but before their next meeting they had not the slightest doubt they would be able to repair it. The repairs cost £30,000 in the half year, which was about 1½ per cent. on their capital. He hoped the current half year would show a decrease for repairs and a substantial increase of revenue. The repairs were, however, quite beyond their control, and at the present moment they had three important cables interrupted, one break having occurred only that morning. Nevertheless, their cables being duplicated and duplexed their revenue was maintained. There was a considerable increase on their general traffic, but on their Egyptian traffic there was a decrease of about £7,000. He believed, however, that they would have an increased traffic with that country as she progressed. He then alluded to his visit last autumn to the Company's different stations in the Mediterranean and the Levant, and referred with great satisfaction to the character of the service, and the confidence reposed in the Company not only for accuracy but also for secrecy. If in the next half year they could declare a bonus in addition to the usual dividend of 5 per cent. he could assure them that it would give them as much pleasure as it would to the shareholders to receive it. They strongly desired to give the idea of permanency to investors in the property.

The VICE-CHAIRMAN (the Marquis of Tweeddale) having seconded the motion, a discussion followed, in which Messrs. Marcus and Newton, Dr. Waller, and Major Leslie, took part.

The CHAIRMAN, in reply, alluded with satisfaction to the existing state of affairs as to the Eastern and South African Telegraph Company and the arrangements they made respecting it. If their policy were followed, he hoped that that undertaking would some day be an appendage of the Eastern Company without having cost them very much. There had been a considerable advance in the value of their property since the picking up of the Direct Lisbon cable under the circumstances referred to. There was no doubt that with increased trade in Egypt their revenue as regarded that country would also increase. On the authority of Sir James Anderson they considered that the new cable had been broken just upon the edge of the bank where the water deepened suddenly, and that the part of the cable that was new would be repaired inexpensively. The breakage was through no defect in the cable. He thought that a permanent 5 per cent., with the prospect of a bonus, was better than a fluctuating dividend. Their reserve fund was £300,000, as against a capital expended of £5,000,000. If they had £500,000 at the credit of reserve fund they could replace any of their cables without going to the public for money.

The motion was unanimously adopted.

On the motion of the Marquis of TWEEDDALE, seconded by the Right Hon. W. N. MASSEY, Mr. Pender was unanimously re-elected a director, a rider being added to the resolution, at the instance of a SHAREHOLDER, expressing sympathy with the hon. gentleman at the death of his second son while in the service of the Company.

The CHAIRMAN feelingly acknowledged the motion, and afterwards submitted a resolution reducing the *minimum* number of directors, other than extraordinary directors, to 7 instead of 8, consequent on the retirement, through his other engagements, of Baron d'Erlanger, who, the Chairman stated with satisfaction, would continue to take as much interest as before in the undertaking.

Mr. G. G. NICOL seconded the motion, and it was carried unanimously.

Major LESLIE gave notice that at the next meeting he would propose an alteration in the Articles of Association, so as to enable the shareholders at the general meetings to alter the recommendations of the directors as to the amount of dividend to be declared.

The auditors, Mr. Henry Dever and Messrs. Quilter, Ball, and Co., were re-elected, and

A hearty vote of thanks to the Chairman and Directors closed the proceedings.

THE UNITED TELEPHONE COMPANY (LIMITED).

The adjourned extraordinary general meeting of the above Company was held on the 27th inst. at the Guildhall Tavern, Gresham-street, under the presidency of Mr. James Brand.

The CHAIRMAN, in opening the proceedings, stated that the meeting was adjourned from the 13th inst., and was called to finish the business that was delayed on that occasion, and to pass the following resolution if the shareholders approved of it:—"That this meeting approves (subject to such modifications as the directors may think fit to make) the agreement, draft of which is now produced, with a Company intended to be formed under the name of the Provincial Telephone Company (Limited), for granting exclusive licenses for the use of the Company's patents in certain districts to subsidiary district companies, to be formed by the Provincial Telephone Company (Limited), partly in consideration of fully paid shares in such district companies and partly in consideration of royalties, and in connection with such licenses to sell for fully paid shares and cash any business now carried on by the Company within the district comprised in such license, and the property used in such business." Having replied in the affirmative to an inquiry whether there was a quorum present, he requested the solicitor to read the draft of the agreement.

The SOLICITOR (Mr. May) accordingly read the draft agreement, setting forth its principal features.

Mr. S. L. PRICE expressed regret that so few were present considering the importance of the agreement. He found that the only cash capital which the district companies would raise was one fourth of the nominal amount of the capital, which was to be raised by preference shares, bearing a cumulative dividend of 6 per cent. The remaining three-fourths of the capital of the companies, consisting of ordinary shares, as he understood it, would be merely so many pieces of paper with the name of the company printed on it, representing not one shilling. He did not understand why the capital was to take this shape. It had been anticipated that the new company would pay considerable dividends, yet they were limited to receive only 6 per cent. for the considerable subscriptions they made to the capital. What he regarded as most objectionable, however, was that this company was to put in its strong box half the number of the ordinary shares of the companies, the value of which was not represented by a penny; and the other half was to be given for the nomination of such district companies to the Provincial Company. This Company was to receive in fully paid ordinary shares of each district company what was equal to 150 per cent. of the amount they subscribed to its preference shares. What was the meaning of that? He found that the Company had spent some £15,000 with respect to these companies, and he gathered that that was to be returned in this manner—they were to have £5,000 in fully paid up preference shares and £5,000 within twenty-one days of the incorporation of the Provincial Company to be paid out of money received in respect of shares; but, supposing that the company did not get this £5,000, in what way were they to be paid. Again, if the Provincial Company anticipated carrying on so good a business as to be able to pay this Company the royalties mentioned, and to give the Company half of its profits, why should not the Company have done all this themselves?

The CHAIRMAN, in reply to Mr. Gower, said that the proposed agreement was made subject to any other agreements that were now in force. Replying to Mr. Price, as to why they did not manage all the business themselves, he stated that they had found the working very difficult indeed, and London itself being such a vast field they had thought that that almost alone would be sufficient for the London management to undertake. What was now proposed was more or less an extension of the plan which they had found to answer so well with the Lancashire Company. The directors of the United Company would have no interest in any shape with the proposed syndicate, as they had in the Lancashire Company.

Mr. J. S. FORBES seconded the resolution, and in doing so stated that the whole Board, both those who had retired and the present members, were quite unanimous in the principle of the agreement, which had been maturely considered. As to the division of the capital into preference and ordinary shares, he had hoped that Mr. Price would suggest some better and practical course. They had had to consider what was the contingent value of an unknown quantity, and the only way they could find to do it was to represent something in the nature of shares, which entitled them to the contingent value as it arose. The figures of 75 per cent. and 25 per cent. were arrived at after much consideration. The 25 per cent. meant the estimated cost of establishing a business in any particular place, and they had retained the power to control that. They were informed that the principle on which they proposed acting was perfectly legal. He quoted from the agreement in answer to other questions.

Mr. PRICE said he did not understand the meaning of allotting half of the ordinary capital in each of the district companies to the Provincial Company for its nomination.

Mr. FORBES stated that the word "nomination" there meant for establishing the district companies as proposed.

The resolution was eventually adopted *nem con.*

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Jan. 26.		Business Done Week Ending Jan. 26. Highest.	Lowest.
Anglo-American Ordinary	60,	¼	60½	59½
Do. "B"	88,	¼	88½	87½
Do. "A"	32,	¼	32½	31
Brazilian	9¾,	10	9¾	9
Cuba	8¾,	9¼	9¼	9
Do. Ten per Cent. Pref.	16¾,	17½	—	—
Direct Spanish	2¾,	3½	—	—
Do. Ten per Cent. Preference	12,	¼	12½	12½
Direct United States	11¼,	½	11¼	11¼
Eastern	9 11-16,	13-16	9¾	9 11-16
Do. Six per Cent. Debenture	104,	106	—	—
Do. Five per Ct. do. 1899	103,	105	106	106
Do. Six p Ct. Pref	12¼,	¼	12½	12½
Eastern Extension	10¾,	¼	10¾	10¾
Do. Six per Ct. Deb	110,	¼	—	—
German Union	10¼,	¼	10½	10½
Globe Telegraph & Trust	6¼,	¼	6¼	6 7-16
Do. Six p Ct. Preference	12,	¼	12½	12½
Great Northern	11,	¼	11¼	11
Indo-European	26,	27	26½	26
Mediterranean Extension	2¾,	3	—	—
Do. Eight p Cent. Pref	10¼,	11	10¼	10¼
Reuter's	10¾,	11¼	11	11
Submarine	263,	268	—	—
West India and Panama	1¾,	¾	1¾	1 11-16
Do. Six per Cent. 1st Preference	6¾	7	6¾	6¾
Western and Brazilian	7¾,	8	7¾	7¾
West. Union 7 p. Ct. 1st Mt.	120,	125	122	122
Do. Six per Ct. Sterg.	104,	107	—	—

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ABSTRACTS OF SPECIFICATIONS.

—o—

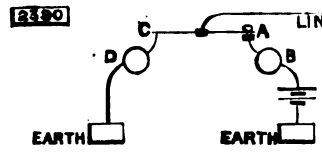
We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts—ED. E.]

2354. BATTERIES FOR THE TRANSMISSION OF SOUND. By *Robert Henelade Courtenay.—Dated, 10th June*, 1880. 2*d*. (*Not proceeded with.*)

This invention has for its object the construction of either a single cell or a series of batteries in such a way as to form either a single or compound transmitter of sound by means of a tension spring adjusted to the negative element of the battery or batteries, the advantages being that no resisting substance is employed in circuit other than the ordinary elements of the batteries and line in the usual way, the result being that more electromotive force is used on the primary circuit of any transmitter constructed on this principle than on that of any other at present known. In some cases a point of carbon also may be used as a continuation of the negative element, which vibrates with the spring, and is affixed to the metal used as a conductor. First. A single cell with the tension spring connected to the negative element and insulated from the porous cell forms an improved microphone and a battery in one instrument. Secondly. The principle admits of a powertul compound battery to be made by making a compound porous cell in the form of a hollow square with partitions in the sides for the negative elements, each element being connected with the other by a rod of carbon terminating with a slab and tension spring, with positive elements inside and outside the square porous cell which is placed in a suitable outer cell. Thirdly. Each cell can be coupled up in the ordinary way according to the distance required to send the message, as in ordinary telegraphs. Fourthly. To make a delicate transmitter with one or more of the cells described it is only necessary to connect a small intensity or other compound coil with the battery, as in the ordinary way, in connection with a receiver and with similar instruments at the distant end. Fifthly. Through being able to use any number of cells it is possible to transmit articulate sounds through a larger amount of induction than can be accomplished by any other transmitter. A single cell is constructed thus :—An ordinary carbon battery is constructed, with the negative element sufficiently long to pass either through a slot in a case made to hold the battery or to meet the contact of the tension spring fixed to an insulator on the porous cell. The spring most desirable in form can be made of any of the usual metals, and be placed over the negative element with a nut screwed on the insulator or the top of the case containing the battery. The nut answers the purpose of adjusting the required tension of the vibratory spring or springs. One or more can be used of any suitable metal ordinarily in use for battery connection. The battery is put into action by switch or otherwise, and connected as described above. Anyone talking near the battery can he heard at the distant end of the line.

2390. IMPROVEMENTS IN AND CONNECTED WITH THE WORKING SIGNALLING APPARATUS. *By George Kift Winter and James Craik.*

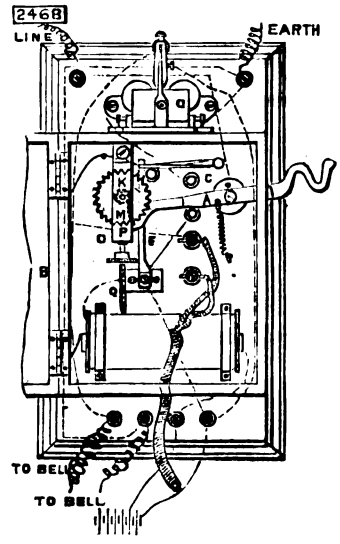
This invention, which relates to various improvements in and connected with the working of railway signalling apparatus, has reference to improvements specially applicable to block telegraph instruments which require the combined action of the signalmen at the ends of a section in order that the indications of the instruments may be varied, so that no signal is complete or indicated by the instruments until it has been acknowledged, the combined action of the signal itself and its acknowledgment being required to cause the instruments to indicate the signal that has passed, and in which the state of the line is clearly indicated, not only as to whether there is a train on the section or not, but also the direction in which a train is travelling over the section, so that neither signalman alone can in any way alter the indications of either instrument; and there is a record at each instrument unalterable by either signalman alone of the last signal which has passed between the instruments, the signalman being thus supplied at a glance with the exact condition of the block section, and having no need to trust to memory or to entries in the signal book, the objects of the present improvements being rendered apparent in the following description. The invention also has reference to the connection of a starting semaphore outside the signal box, and in view of the driver of the train with the block instruments, in such a manner as that it cannot be lowered to allow a train to leave until "line clear" has been received from the other end of the section, and with an attachment to the permanent way in such a manner as that it is automatically put to "danger" by the passage of a train when entering the section, and can only be lowered by the combined action of the signalmen at the ends of that section, as and at the times hereinafter described. In the block instruments to which the present improvements have especial reference (though they or equivalent modifications thereof are also applicable to other forms of block instruments in present use to enable them to control the semaphore hereinafter described) there are two "indicators" on each instrument, one, which is painted "black" and is marked "train going to," and is termed the "train going" indicator, referring to trains leaving the station, and the other, which is painted red and is marked "train coming from," and is termed the "train coming" indicator, referring to trains approaching the same, the name of the station with which the instrument is connected, as the other terminal of the block section, and which consequently forms the last word of each of the above phrases, being immediately underneath and common to both dials. The needle of each indicator has two positions, viz., "clear" or "cleared," and "on line," from one to the other of which the needles are actuated by coils which are not in the line circuit, so that no alterations in the indications of the instruments can be caused by lightning or by contact between the block or line wire and any other. In order to move either of the indicator needles from one position to the other, it is necessary that the



tongue of a polarised relay should be moved from one position to another with the object of reversing the direction in which a local current when it flows will circulate the wire of the indicator coils, and that the circuit of the local battery should be then completed. It should be borne in mind that the fundamental object of the arrangement now being described is the placing of the apparatus for controlling the direction of the local current which actuates the indicators under the power of the signalman at one end of the section, and the apparatus for completing the circuit in the power of the signalman at the other end of the section, so as (as above referred to) to render necessary the combined action of the signalmen at the ends of a section in order to make any alterations in the indications of the instruments. Suppose a key of the form shown is used for giving signals, then it is evident that any apparatus, such as B, that may be placed between the contact point A and the battery or between the latter and "earth" is affected only by the outgoing signals, and is therefore entirely under the control of the signalman at the instrument, and that any apparatus, such as D, that may be placed between the back contact point C and "earth" is acted on only by signals from the "distant" station, and is therefore under the control of the signalman there. If, therefore, the relay for controlling the direction of the local current acting on the "train going" indicator be placed at D, and the apparatus for completing the circuit be placed at B, it is evident that though the signalman at the distant station can control the relay D, and, consequently, the direction of the local current, he cannot cause the local current to act on the indicator, as the local circuit is not completed until the key at C at the near end is depressed. In like manner, if the relay for controlling the direction of the local current acting of the "train coming" indicator be placed at B, and the relay for closing the circuit be placed at D, the combined action of the signalmen at the ends of the section is required to move the "train coming" indicator. The inventors make six claims referring to the starting semaphore, the combination of block instruments, the putting of semaphore arm to danger, locking and unlocking the arm, and the use of the starting semaphore and its attachments with the block instruments.

2468. IMPROVEMENTS IN APPARATUS EMPLOYED IN TELEPHONIC SIGNALLING. *By Edward Hibberd Johnson.—Dated 18th June*, 1880. *Price* 6*d*.

This invention relates to improvements in that description of apparatus employed in telephonic signalling in which a movable hook or support carrying the telephone receiver is used for the purpose of automatically controlling the connections and effecting the signals, and the object of the invention is to increase the efficiency of such apparatus, and to obviate the defects to which existing apparatus of this character are subject. In carrying out this invention, the inventor retards the movement of the lever carrying the hook or support, or of a lever or other device in connection therewith, by the employment of an escapement or equivalent mechanical contrivance, thus affording the requisite time for making one or more effective contacts between the signalling battery and the line, whether the hook or support be moving upwards or downwards. This result may be conveniently accomplished by providing on the inner extremity of the hook lever a toothed segment, which engages with a corresponding toothed segment or pinion forming part of an ordinary escapement, or the extremity of the lever may be loosely pivotted to a segmental serrated wheel with which engages the pallets of the escapement, or the extremity of the lever may itself be serrated for the pallets of the escapement to engage therewith, or the retarding movement of the escapement may be applied to the hook lever in any



other suitable manner. The figure in the accompanying drawing represents a front elevation of a signalling apparatus constructed according to one modification of this invention. A is a vibrating lever mounted upon a centre or fulcrum in a case, B, and terminating at its outer extremity in a hook or support for carrying the telephone receiver C, in the usual manner. There is a binding screw, through which the relay D, which brings into operation a bell or other signalling device (not shown in the drawings) is placed in circuit with the line when the lever A is in the position indicated, with the telephone receiver C on the hook or support. Another binding screw through which the telephone receiver C is placed in circuit with the line when the telephone is off its hook or support, *b*, and the lever A is in the position shown in figure, the bell or signalling device being then cut out. E is another vibrating lever mounted upon a centre or fulcrum. This lever, when the parts are in the position indicated in figure, is in contact at its upper extremity with a binding screw, which places the transmitter F in circuit, the lever being connected to a conductor leading to the battery G. The lever E is usually made with an insulated and an uninsulated portion, in order that as a portion of the lever in its upward and downward motion passes over the uninsulated portion of the lever E, the circuit being completed with the line, a pulsation may be sent to the signalling apparatus of the station to be communicated with. The different connections are clearly indicated in the drawing, and, being of a well-known arrangement, require no special description. The levers A, E, in so far as they have been already described, form also a part of arrangements in common use

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SLIP

CABLE INTERRUPTED.—The Rio Grande do Sul—Monte Video section of the Western Brazilian Company—is reported as interrupted.

ELECTRIC LIGHT AT BRISTOL.—The experiments were continued every evening last week; the light is spoken of as being brilliant and steady.

TIME SIGNALS IN FRANCE.—We learn that noon is to be signalled, in country towns as well as in Paris, from the Observatory. This will be a great boon to the public.

SILVER PLATING.—In plating German silver H. Krupp, of Vienna, first deposits a galvanic coating of nickel, next a coating of copper, and finally a coating of silver.—*Dingler's Journal.*

OBSTRUCTION.—No relief having been provided, the telegraph clerks at the House of Commons were, says the *Daily News*, on duty during Monday and Tuesday, for 24 hours at a stretch.

TELEGRAPH MONOPOLY IN AMERICA.—The amalgamation of the companies now being proceeded with will, it is said, result in the capitalisation of 80,000,000 dollars in the hands of one company.

THE EASTERN TELEGRAPH COMPANY.—This Company announces that the half-yearly interest on the Five per Cent. Debentures will be paid on and after February 1 by Messrs. Glyn, Mills, and Co.

ERRATUM.—Mr. Heaviside's paper at the last meeting of the Society of Telegraph Engineers was on Induction. A typical error in our report described the subject as "Education." We regret that we cannot find room for the paper.

ATLANTIC CABLES.—In reply to several correspondents we have to state that our note of last week with regard to the stoppages of the construction of cables was premature. The statements, however, are so conflicting that at present we wait the development of events.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—The next meeting will be held at the Institution of Civil Engineers on Thursday, February 10, 1881, when a paper on "Earth Currents—Electric Tides," by Alex. J. S. Adams, Associate, will be read.

CAUTIOUS OFFICIALISM.—From Switzerland we hear that: "The Municipality of Zurich have refused permission for the placing of telephone wires on the public buildings of the city, on the ground that their tenuity renders them attractors of lightning, and, therefore, dangerous."

PROFESSOR HELMHOLTZ IN LONDON.—The Faraday Lecture will be delivered by Professor Helmholtz in the theatre of the Royal Institution on Tuesday, April 5. The subject will be "The Modern Development of Faraday's Conception of Electricity." The lecture will be delivered in English.

PUBLICATIONS.—Mr. J. E. H. Gordon's work on "Electricity and Magnetism" has been translated into French and published in Paris. The large first edition of Mr. J. T. Sprague's "Electricity" is almost exhausted, and we understand the author contemplates various alterations and extensions in a new edition.

A NEW COMPANY.—We understand that a new company has just been formed for the purpose of taking up and working the electric light apparatus of Mr. Desmond G. FitzGerald. The apparatus consists of a dynamo-electric machine (*v. Electrician*, vol V., p. 224), a lamp on the incandescent principle, also one on the arc principle.

THE SCARE STILL.—At a recent meeting of the Mansfield Improvement Commissioners, having under consideration tenders for the erection of a new gas holder at the gasworks, several members spoke of the desirablity of not proceeding too fast with the erection of expensive additions as the electric light would probably soon supersede gas.

THE TELEGRAPHISTS OF DUBLIN.—In the House of Commons on the 27th ult. the Postmaster-General, replying to Mr. M. Brooks, the member for Dublin City, stated that an inquiry was now being made into the position and prospects of telegraphists generally, and that any decision arrived at would, of course, apply to Dublin, as well as to other places.

PRICES.—The prices of gutta percha as quoted are:—For genuine 4d. to 3s. 3d. per lb., for reboiled 3d. to 1s. 3d. per lb. India rubber, per lb.:—For Para (fine) 3s. 5d. to 3s. 5½d., Negrohead 2s. 4d. to 2s. 5d., Central American 1s. 9d. to 2s. 5d., Assam and Pegu 1d. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 4d., Madagascar and Mozambique 1s. 8d. to 2s. 4d.

THE CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED).—The number of messages passing over the lines of this Company during the month of January was 2,603, estimated to produce £2,800, against 2,891 messages, producing £3,406 in the corresponding month of last year. The traffic receipts for the month of November, estimated at £1,900, realised £1,950.

COMBETTE'S ELECTRIC CANDLE.—This, another ingenious pipe lighter, is composed of a bichromate of potash battery enclosed in a bottle hermetically sealed, the two poles of the battery being connected with a very thin platinum spiral, placed above the candle. To light it, it is only necessary to tilt the bottle, when the battery becomes active and heats the spiral.

METEOROLOGICAL DISTURBANCES.—From Austria we hear of severe snowstorms which have interrupted all traffic in many places, particularly in the Tyrol, from whence also are reported severe shocks of earthquake, the direction being north-east to south-east. The date of these shocks is said to coincide with that of those reported from Switzerland, viz., about the 28th January.

ANOTHER COMPANY.—A prospectus has been issued of the "Compagnie de Télegraphie Sous-Marine de|l'Amérique Centrale," which has been formed in Paris to establish telegraphic communication between Central America, the United States, and Europe by means of a cable from Belize to Cuba under special guarantees and concessions. The capital is 3,000,000f.—£120,000—in 6,000 shares of 500f., or £20 each

ELECTRIC LIGHT AT HULL.—There is some idea of lighting the Hull Docks by electricity. The Hull Dock Company have invited the Corporation to join them in the contract, and the latter are favourably disposed to the idea. We believe that two tenders have been received, viz., from the Anglo-American Electric Lighting Company and Messrs. Siemens Brothers. The matter at present awaits the report of the borough engineer.

TELEPHONIC COMMUNICATION.—At a recent meeting of the Clerkenwell Vestry the question of establishing telephonic communication with the wharf was considered. The United Telephone Company offered to do it for £30 per

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annum, and the Gower-Bell Telephone Company for £26, the latter suggesting that the Post Office should be asked to provide the necessary wire. The consideration of the subject was adjourned for six months.

Underground Telegraph Wires.—In the House of Commons, on the 27th ult., the Postmaster-General, in answer to Mr. O'Donnell, said that while there were at the present time more than 9,000 underground wires in London and other towns, the expense that would be incurred in converting the overground wires from London to the provinces into underground wires would be so great that it was out of the question to introduce the system.

The Telephone in Italy.—The *Daily News* correspondent writes:—"The celebrated astronomer, Father Deuza, recently made the first experiments in Italy with a microtelephone on the line of railway from Turin to Lanzo, which is about twenty miles long. The voice was not only distinct and clear, but so strong that it was heard all over the room at Lanzo in which the experiments were made. Conversation between the two interlocutors was as animated as if they had been in the same place. Induction from neighbouring wires, though heard in the intervals, did not interfere with the speaking."

Aurora Borealis.—A beautiful display is reported in a letter to the *Standard* as having taken place on the 31st January in the neighbourhood of Wimbledon. The writer describes it as "a magnificently luminous fan-shaped formation of white cloud, which lasted some minutes, during which rays of every shade of pale blue, violet, and towards the east, blood red, were shot up far into the clear sky, accompanied by a universal quivering and fluttering of light all over the northern heavens." This display is said to have been at its best just before 7 p.m. It was also witnessed at Sheffield and other places.

International Exhibition.—Our contemporary, *L'Electricité*, calls upon intending exhibitors to notify their intention as soon as possible, so as to facilitate the laying out of the different sections. It also states that there is every intention of permitting exhibitors to sell any article provided they are replaced on the following morning by another of the same kind, and that they are not taken away until the public have left. The cost of transport will fall on exhibitors, but it is probable that railway companies will allow a reduction of 50 per cent. on ordinary rates. When are we going to stir in this matter?

New Kind of Electro-dynamometer.—At a recent meeting of the Société Française de Physique M. Niaudet presented an apparatus by M. Ader, intended to show the action of telegraphic currents. It is a kind of electro-dynamometer. The current traverses two fixed coils, and a movable one placed between these two; this movable coil is fastened to the end of a magnetic needle. The rotation axis of this needle is formed of two pieces of metal, each communicating with one of the ends of the wire of the movable coil, and separated by an ivory insulator. The deviation is greater with sharp than with deep sounds, very clear with the sound O or Ou, feeble with i.

Mesmerism.—The English newspapers have been much exercised in regard to the unseemly incident recently enacted in a Paris law court on the person of a clairvoyant who had got into trouble while in one of his "trances." It certainly is surprising that the antics of this feeble wretch under the supposed influence of his doctors should be deemed proof of irresponsibility when no doctors are with him; but there is nothing new in the phenomena—a big volume-full of such was published by Reichenbach thirty-five years ago. If our readers ask what this has to do with electricity or magnetism we simply answer that we do not know—some people think it has a great deal, that is all.

Phosphor Bronze Telegraph Wires.—M. E. Bède, formerly Professor at the Liége University, has recommended the use of phosphor bronze for wires instead of iron, phosphor bronze having four times the conductibility of iron, and being from three to four times as strong as steel. Aerial lines have the advantage of being easily inspected, but the disadvantage of being liable to accident, while underground lines are almost free from accident, but difficult of inspection. That inventor would render great service to telephonic communication who should devise a cheap method of constructing underground lines that should at the same time permit of easy and complete inspection.

Victorian Telegraphs.—The *Statistical Register* for Victoria gives us an insight into the development of telegraphs in the colony during the last ten years, 1870-79. The number of stations which in 1870 was 95, in 1879 was 257, whilst the miles of wire had increased between the same years from 3,371 to 5,736; the numbers of paid and unpaid telegrams in 1870 were respectively 393,964 and 60,634, whilst in 1879 they were 725,799 and 284,317, the total amount received during the same years being £33,146 and £1,010,116. On the 1st January, 1870, the rate for telegrams was fixed at a uniform rate of one shilling for 10 words. Figures like these speak for themselves.

Large Telegraph Wires.—At the recent meeting of the American Electrical Society in Chicago, Colonel C. H. Wilson read a paper on the use of large telegraph wires. He held that the employment of large gauge wires for the quadruplex circuit was an advantage. A No. 4 wire recently laid between New York and St. Louis was giving entire satisfaction. The question had been raised whether, in the desire to increase the conductivity of the wires, there was any limit to their size. There was a limit, and the conductivity could be increased by employing different conductors, copper instead of iron wire, for instance. In a discussion which followed, Mr. Somers advocated the use of large wires, and said that their employment had simplified the quadruplex problem.

Another Attack on a Telegraph Clerk at Smyrna.—One of the Eastern Telegraph Company's clerks, M. Esperon, has been made the subject of an unprovoked and brutal attack. It appears that M. Esperon was walking about three-quarters of a mile from the railway station of Aidin, when he was surrounded by three persons, one of whom asked him for a light for his cigarette. Seeing that none of them had a cigarette, he stepped back, and drew his revolver, telling them to keep off or he would fire. Upon this they assumed the "injured innocence" air, and M. Esperon, thinking he must be mistaken, replaced his revolver; immediately they sprang on him; he was knocked down by a cutlass, robbed, and disarmed. The brutes then retired a few paces, and shot at him with his own revolver, happily without effect. Several persons looked on at this scene with calm indifference.

Underground Wires for New York.—A lecture on this subject has been delivered by Mr. R. D. Radcliffe in the Cooper Institute. The lecturer stated that all efforts in this direction had failed so far in the United States, but had been measurably successful in Europe, because Government had supported the movement in the latter, whilst in the former it was dependent on private aid and capital. He stated that

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there were over 300 wires, extending north and south in New York, whose total length was 6,600 miles, and that of this length about 1,800 miles were put up last, and 3,600 miles would probably be added this year. It would be practicable, he said, to have underground lines of wires running north and south through a tube or pipe, with vaults at the corners at every two blocks distance and manholes to give access to them. One set of wires would do for all the companies if they would act in harmony. He estimated the cost of this system roughly at about 300,000 dollars.

COMPETITIVE EXAMINATION FOR THE TELEGRAPH DEPARTMENT.—In reference to this subject Mr. Fawcett stated in the House of Commons a few evenings ago that open competition already prevailed as regards male telegraphists in the metropolis, and added—"As regards throwing open for competition the situation of female telegraphist in the metropolitan offices and that of male telegraphist in Edinburgh and Dublin, that course will be adopted so soon as the list of candidates who have already been promised nominations is exhausted, and so far as I am able to judge the present list will be exhausted about the end of the present year. With the object of bringing the system of open competition into operation as soon as possible, I have for some time refused all applications for nominations. Ample notice will be given in the public journals of the time when the system of open competition will be brought into operation and of the regulations under which it will be held."

TELEGRAPH SERVICE TO THE CAPE.—The following letter has appeared in the *Daily News*:—"Sir: In your issue of this date reference is made to the excellence of the telegraph service to the Cape, by which the Right Hon. H. Childers was enabled to complete a correspondence between himself and Sir George Colley within sixteen hours. I desire to state that the average time of transmission of all telegrams from the station near Sir George Colley's force was 2 hours 30 minutes, and the actual time from Durban to London was 50 minutes for all Government messages. In the concluding paragraph of the notice referred to you say:—'We are authorised to state that in cases where relatives of officers or men serving in the Transvaal are in doubt as to the fate of their friends a message of inquiry will be transmitted without charge.' What the company have promised is that we are prepared to transmit free all messages from the relatives of wounded or missing officers who are anxious to make inquiries if the messages are handed to us by the War Office or anyone appointed by the Government to do so.—Yours truly, JAMES ANDERSON, Managing Director of the Eastern and South African Telegraph Company (Limited).—66, Old Broad-street, E.C., Feb. 1."

TROOPS STRUCK BY LIGHTNING.—"A terrible experience—almost unique in military annals—is," says the *Colonies and India*, "recorded by a correspondent at the Cape of Good Hope in connection with the march of the Diamond Fields Horse to the scene of operations in Basutoland towards the end of last year. The men had outspanned for breakfast, when a heavy thunderstorm suddenly burst over them so severe in its effects that they were forced to abandon their attempt to procure a meal, and remounted in the hope of riding out of the storm. Towards three in the afternoon, however, it broke upon them with increased violence, the rain falling apparently in sheets and the flashes of lightning appearing continuous. At last a flash struck the troop, flinging seventeen horses with their riders to the ground, and killing ten men and five horses on the spot. Those who were not killed were all seriously injured, and it was long before animation could be restored in the case of seven of the men. The bits and stirrup-irons of the whole number were blackened, and many of the men, though personally uninjured, had their clothing rent by the force of the electric discharge. The greatest difficulty was naturally experienced in preventing a general stampede among the frightened horses."

TELEGRAPH CLERKS' GRIEVANCES.—The clerks of the staff of the Central Telegraph Office in London, to the number of 610, have presented a memorial to the Postmaster-General, asking that the recommendations of the Playfair Commission should be applied to them, and that such application be retrospective. They submit that, as their duties exceed six hours per diem, their salaries, in accordance with paragraph 13 of the Order in Council dated February 14, 1876, may commence at the higher scale of pay, viz., £90 per annum, and rise, by triennial increments of £15 to £250 per annum; that junior clerks may commence at 16s. per week, and rise annually by 2s. per week to 28s., and that after reaching this salary they shall receive their appointment as clerks; that overtime be paid for without deduction for holidays or partial holidays, and that the payment bear to the hour the same proportion as the salary bears to forty-two hours, and that Sunday, Christmas Day, and Good Friday continue to be paid for as overtime, and further, that when clerks perform duty on any of the Bank holidays or on the Queen's Birthday, they be allowed a day's leave in lieu thereof; and that every clerk receiving not less than £90 per annum be allowed annually one calendar month's holiday, and junior clerks twenty-one days.

GASEOUS SARCASM.—We have been greatly amused by some remarks of our contemporary, *The Journal of Gas Lighting*, &c., with reference to Mr. Crompton's lecture on the "Electric Light," a notice of which appeared in our last week's issue. The *Journal* waxes very jocose at the expense of electricians. It says:—"When electricians do agree their unanimity is wonderful. . . . The most striking characteristic of Mr. Crompton's lecture was the magnanimity he displayed in praising the systems of Mr. Swan and Mr. St. George Lane Fox to the disparagement of Mr. Edison. He is reported to have stated that Mr. Edison's efforts to invent an electric lamp had been forced on by certain speculative geniuses in Wall-street, and he expressed some regret that the efforts of English electricians were beginning to lose interest for the general public because of Mr. Edison's failure. He predicted that Mr. Swan's light, or something very like it, would be the domestic lamp of the future, but of course he was careful not to fix the day when the last gas-burner will be turned off for good. Surprising as it may seem, Mr. Crompton actually showed his audience the difficulty that in his own and other arc-lamps attends the adjustment of the carbons! This is pushing candour almost to the extreme of artlessness, and although it is not stated that the lecturer described his own lamp as the worst of the lot, his audience must have been greatly impressed with his simple modesty in laying bare the weak point of his own invention. When it is added that Mr. Crompton's lecture was given in a room illuminated by Mr. Swan's lamps, we only want to hear that Mr. St. George Lane Fox acted as the lecturer's assistant, and lent those diagrams—which did not appear at Lincoln on a recent occasion—for the purpose of illustrating the address, to believe that the Millennium will dawn at about the same time as gas goes out before the electric light." With all due respect to the *Journal*, we wish we were as sure of the dawn of the Millennium as we are that gas will pale before its more brilliant compeer.

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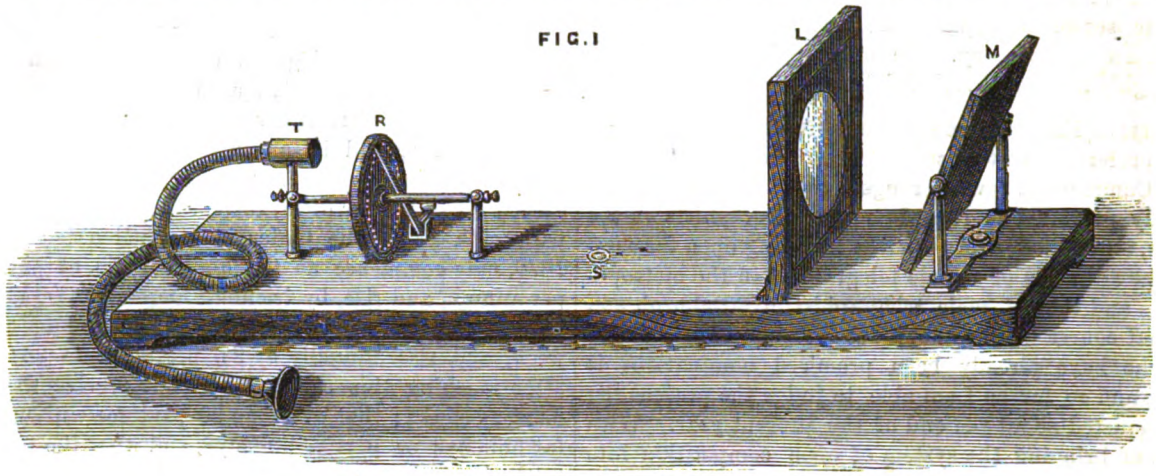
BELL'S PHOTOPHONE.

The accompanying illustrations (reproduced from *La Nature* by the *Engineer*, to whom we are indebted for them) give a good idea of the apparatus used by Professor Bell. We have in previous issues fully reported Professor's Bell's lectures upon his discoveries, and to a certain extent illustrated the descriptions given, but we do not hesitate to give this further short article.

FIG. 1



Professor Bell and Mr. Tainter commenced their investigations as a development of the theory of the telephone. In the telephone a vibrating diaphragm, moving in unison with the vocal sounds produced by the speaker, influences an electric current so

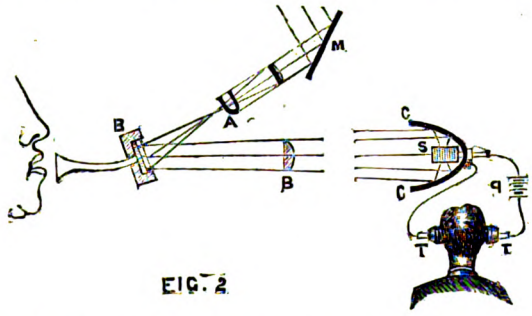


FIG. 2

as to make it vary in intensity in accordance with the sound waves. Knowing that the material selenium is strangely affected as regards its electrical properties by the action of light, Professor Bell and Mr. Tainter thought that by influencing the light waves falling on selenium by sound waves they would be able also similarly to influence an electric current.

The first object of the investigators was to obtain the selenium as a working substance, and then to construct an apparatus with a large surface of selenium in the circuit.

Professor Bell and Mr. Tainter finally decided to use a number of round brass discs, about 2in. in diameter, and a number of mica discs of a diameter slightly less, piled upon one another so as to form a cylinder about 2½in. in length. These were clamped together from end to end, the clamping rods also serving to unite the discs of brass electrically in two sets, alternate discs being joined, the 1st, 3rd, 5th, &c., in one series, 2nd, 4th, 6th, &c., in another series. This done, the edges between the brass discs were filled with selenium, which was rubbed in at a temperature sufficiently high to reach the melting point of selenium.

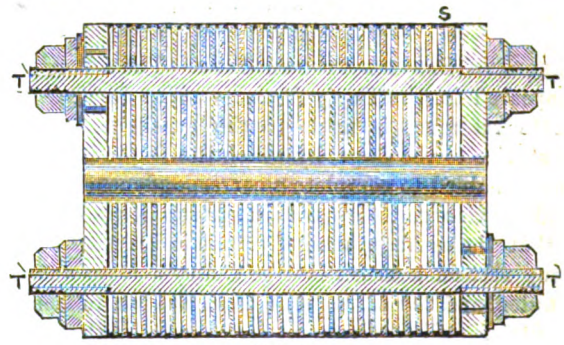


FIG. 3

After this the selenium was carefully annealed to bring it into the sensitive crystalline state. The cell is then placed in a lathe and the superfluous selenium turned off until the edges of the

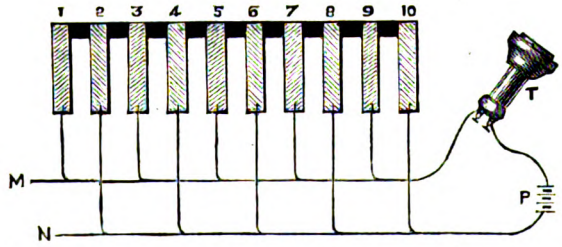


FIG. 4. DIAGRAM SHOWING THE ACTION OF THE SELENIUM RECEIVER

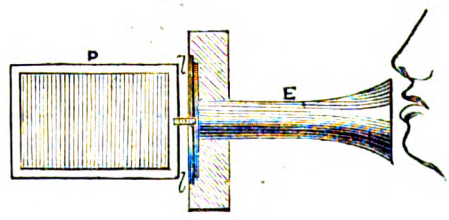


FIG. 7. SLOTTED TRANSMITTER

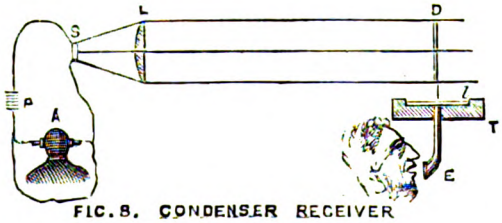


FIG. 8. CONDENSER RECEIVER

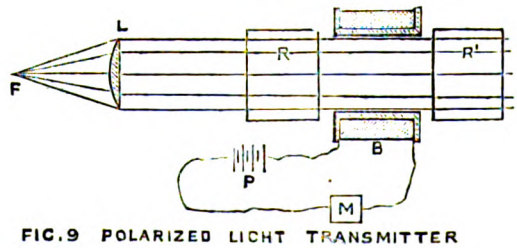


FIG. 9 POLARIZED LIGHT TRANSMITTER

brass discs are bared. Fig. 3 shows, in section, the construction of such a cell.

Fig. 4 is a diagram which simply illustrates the action of the selenium receiver, and shows, first, the way of connecting the alternate discs; and, secondly, that the current from the battery P cannot go round the telephone circuit without passing some-

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where through selenium from one brass disc to the next. The special advantages of the "cell" devised by Professer Bell are, that in the first place the thickness of the selenium that the current must traverse is nowhere very great; that in the second, this photo-electrical action of light on selenium being almost entirely a surface action, the arrangement by which all the selenium used is a thin surface film could hardly be improved upon; and that, thirdly, the symmetry of the cylindrical cells specially adapts it for use in the parabolic mirror.

Photophones have been classed as (1) articulating photophones, and (2) musical photophones.

Fig. 1 illustrates the simple musical photophone of Bell and Tainter. It might perhaps be described without injustice as an optical siren, producing sounds from intermittent beams of light, as the siren of Cagniard de Latour produces them from intermittent puffs of air. A beam of light from the sun or from a powerful artificial source, such as an electric lamp, falls upon a mirror, M, and is reflected through a large lens, L, which concentrates the rays to a focus. Just at the focus is interposed a disc pierced with holes—forty or so in number—arranged in a circle. This disc can be rotated so that the light is interrupted from one to five or six hundred times per second. The intermittent beam thus produced is received by a lens, T, or a pair of lenses upon a common support, whose function is to render the beam once more parallel, or to concentrate it upon the disc of ebonite placed immediately behind, but not quite touching them. From the disc a tube conveys the sounds to the ear. We may remind our readers here that this apparent direct conversion of light into sound takes place, as Professor Bell found, in discs of all kinds of substances—hard rubber, zinc, antimony, selenium, ivory, parchment, wood—and that he has lately found that discs of carbon and of thin glass, which he formerly thought exceptions to this property, do also behave in the same way.

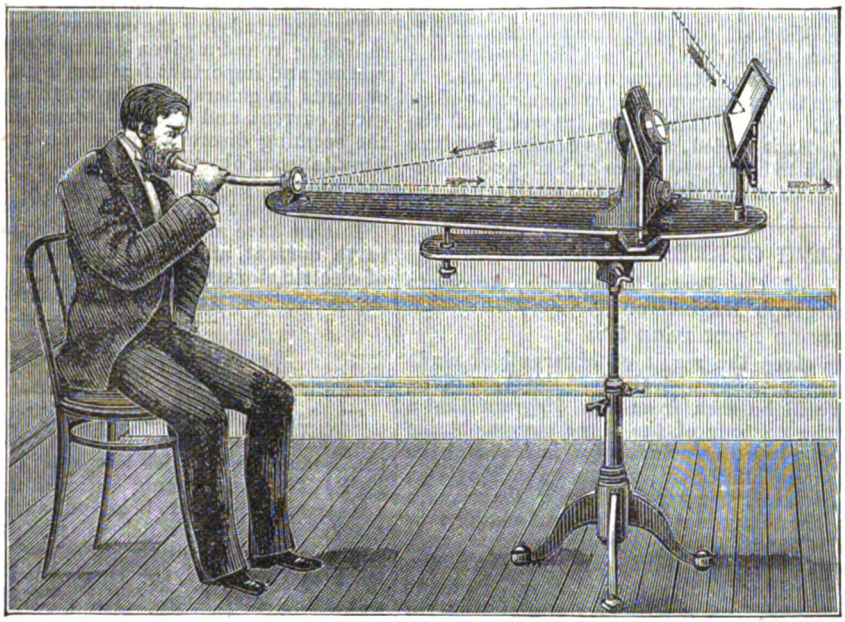

FIG. 5

This photophone produces very distinct sounds, of whose existence and dependence for their production on the light the listener may satisfy himself by cutting off the light at any moment with the little opaque disc fixed on the end of the little lever just in front of the holes in disc R, and which can be worked by a Morse key like a telegraph instrument, thus producing at will alternate sounds and silences. With this musical telephone sounds have been carried by an interrupted beam of light for a distance exceeding a mile.

The articulating photophone is that to which hitherto public attention has been most largely directed, and in which a selenium receiver plays a part. Fig. 2 gives in diagram form the essential parts of this arrangement. A mirror, M, reflects a beam of light as before through a lens, and—if desired for the purpose of experimentally cutting off the heat rays—through a cell, A, containing alum water, and casts it upon the transmitter B. This transmitter, shown again in Fig. 5, consists of a little disc of thin glass, silvered on the front, of about the size of the disc of an ordinary telephone, and mounted in a frame, with a flexible india rubber tube about 16in. long leading to a mouthpiece. A second lens, R, interposed in the beam of light after reflection at the little mirror renders the rays approximately parallel.

It may be well to explain how the vibrations of the voice can affect the intensity of the reflected beam far away. The lenses are so adjusted that when the disc B, is flat—that is, when not vibrating—the beam projected from the apparatus to the distant station shall be nearly focussed on the receiving instrument.

Matters being thus arranged, when the speaker's voice is thrown against the disc B it is set into vibration, becomes alternately bulged out and in, and made slightly convex or concave, the degree of its alteration in form varying with every vibration of the the voice. Suppose at any instant—say by a sudden displacement such as takes place when the letter "T" is sounded—the disc becomes considerably convex, the beam of light will no longer be concentrated upon the receiving instrument, but will cover a much wider area. Of the whole beam, therefore, only a relatively small portion will fall upon the receiving instrument, and it is therefore possible to conceive that, if perfectly adjusted, the illumination should be proportional to the displacement of the disc, varying, therefore, with every vibration and with utmost fidelity. The receiver of the articulating photophone is shown on the right-hand side of the diagram, Fig. 2. A mirror of parabolic curve, C C, serves to concentrate the beam, and to reflect it down upon the selenium cell S, which is included in the circuit of a battery, P, along with a pair of telephones, T and T. Fig. 6 illustrates the principal parts of the apparatus. The sensitive selenium cell is seen in the hollow of the parabolic mirror, which is mounted so as to be turned in any desired direction. The battery standing upon the ground furnishes a current which flows through the selenium cell and through the telephones. When a ray of light falls on the selenium—be it for ever so short an instant—the selenium increases in conductivity, and instantly transmits a larger amount of electricity, and the observer with the telephones hears the ray, or the succession of them—hears

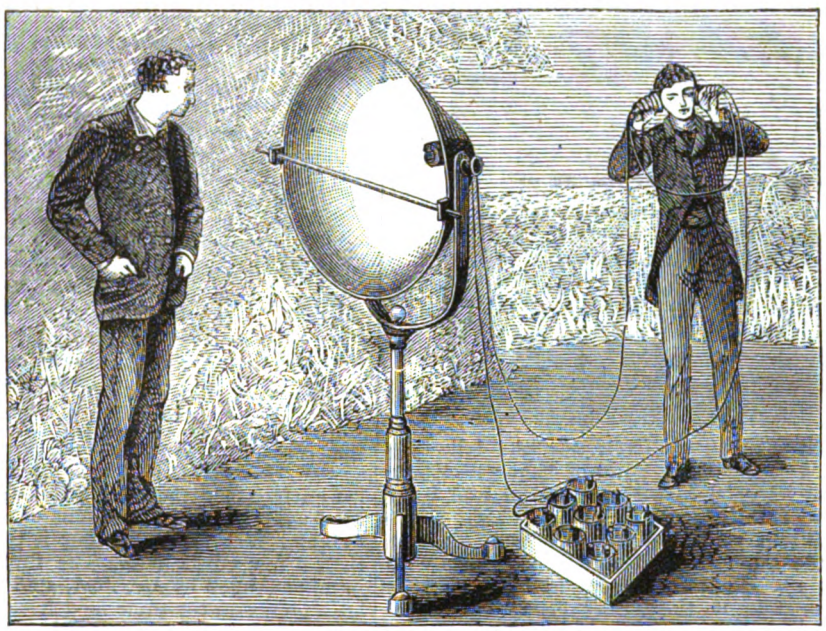

FIG 6

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indeed, their every fluctuation in a series of sounds which, since each vibration corresponds to a vibration of the voice of the distant speaker, reproduce the speaker's tones.

The transmitter shown in Fig. 7 consists of a fixed plate, P, provided with numerous slots and of a like movable plate attached to the diaphragm *l l*, mounted in a frame provided with a mouthpiece, E. The vibration of the movable plate varies the intensity of the light passing through it. In Fig. 8 the transmitter is shown as used in combination with a collecting lens, L, in place of the parabolic reflector. In Fig. 9 a transmitter is shown which is based upon the effect of electricity on polarised light. A lens, L, throws the beam of a light, F, upon a Nicol polarising prism, R, and the polarised beams traverse an analyser, R'. A helix, B, is placed between the two prisms and in the circuit of an ordinary microphone, M. By speaking, the intensity of the current traversing the helix is varied, and this causes the plane of polarisation of the rays to be turned more or less, and consequently more or less rays are extinguished by the analyser R.

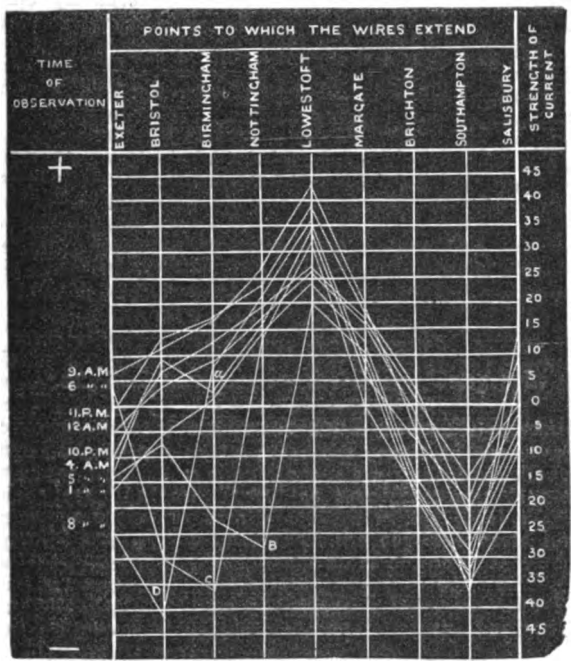
EARTH CURRENTS.

By Alex. J. S. Adams, of the Postal Telegraphs, Associate Telegraph Engineers.

(concluded from page 53.)

The following diagram gives the result of observations made upon the eight wires simultaneously with those of the three given in the last diagram. It will be seen from this diagram that a general coincidence in the contour of the three curves obtains from 10 p.m. until 5 a.m., when the coincidence is lost and the general contour of the curves is more or less upset; and further, that at 9 a.m., four hours later, the previous coincidence again presents itself. From the diagram, then, we are enabled to arrive at the *time* and the *duration* of a temporary disturbance in the ordinary agreement of the variations upon the three wires.

By reducing the results of the simultaneous observations made upon the additional wires into *directive force* curves we also obtain the *direction* taken by the disturbing force, and the locality



over which that disturbance manifests itself. In the following diagram the observations—agreeing in point of time with those of the last diagram on page 52—are thus reduced, and upon examination their curves, which from 10 p.m. to 5 a.m. maintain a contour similar to that portrayed in the second diagram on page 52, are from the latter hour also disturbed—*so far as regards the wires that radiate in a westerly and north-westerly direction.* For instance, at 4 a.m. the disturbance first indicates its presence by a sinking of the ordinary curve at Birmingham, as at A, the curve otherwise maintaining its agreement with those previous to it. At 5 a.m. the disturbance is more marked, and reduces not only the Birmingham current but also that at Nottingham, as at B, and from this it appears that the disturbing effect has moved further to the north—of London—and makes itself felt over the district comprised between and around Bristol, Birmingham, and Nottingham. At 6 a.m. the disturbance has passed back again in a westerly direction, and upsets both the Bristol and Birmingham curves, as at C, the Nottingham current returning to its original position.

At 8 a.m. the disturbance appears to have got directly west and to upset the Bristol curve only as at D, after which it so far subsides that the 9 a.m. curve quite coincides with those of the earlier hours.

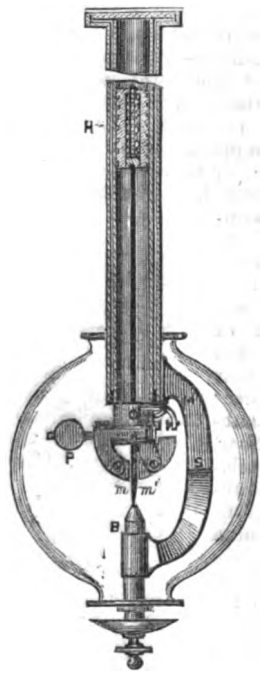
Thus it will be seen that side by side with the earth current proper there exist temporary electric storms, more or less local, sometimes in one locality, sometimes in another, and occasionally influencing the whole of the kingdom, the rising and subsidence of which may be clearly traced and mapped out by such observations and curves as we have here discussed.

By thus studying the comparative results of a number of wires radiating round a given centre we are able to detect most interesting and important features bearing upon the subject of earth currents in general, and upon the relation between the normal earth current and electric storms in particular, and to see that the seeming discrepancy in the agreement of the results of simultaneous observations upon two or more wires is rather the outcropping of an independent effect than the discrediting of the conclusions drawn from the second diagram on page 52.

But we have much more to advance in respect to the normal earth current, and must, therefore, leave a further consideration of electric storms for the present.

NAPOLI'S ELECTRIC LAMP.

The incandescent lamp of M. Napoli belongs to that intermediate class which come between the simple arc lamps and the continuous heated wick lamps of Swan, Edison, and others. M. Emile Regnier, a young Parisian mechanician was, so far as we are aware, the first to bring out such a lamp in recent years, and his earliest form, which we saw at work in Paris during the summer of 1878, consisted of a fine carbon pencil touching a thick carbon roller, the current being passed from the pencil to the roller and heating the pointed end to a white heat in its course. Mr. Werdermann soon after exhibited a lamp of the



same order, which gave a more powerful light and was of simpler action. It consisted of a pointed rod of carbon impinging on a flat surface of carbon, not a roller; and the pencil was fed forward as it consumed by means of a system of cords, pulleys, and weights. Werdermann's lamp is too well known to require more than a few words here. The first form of it has been greatly improved upon by Mr. Joel, and M. Regnier has fashioned his later lamps on the same model.

The incandescent lamp of M. Napoli, which we are now enabled to illustrate, thanks to our excellent French contemporary, *La Lumière Electrique*, bears a considerable resemblance to the later forms of the Regnier lamp. Nevertheless, it differs from these in the jaws which grip the carbon rod, and in having a spring clasp, intended to close the circuit of the current. When the carbon rod is consumed or faulty, this device prevents any other lamps in circuit from suffering an interruption of its light.

In Napoli's lamp the current arrives by a central tube, at the extremity of which are two copper jaws, marked *m m'* in the figure. These jaws are thinner than the carbon rod on which they

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bear. One of them, *m'*, is ordinarily fixed, but can be advanced a little if need be. The other, *m*, is pivotted, and made to press forcibly on the carbon rod by means of the weight marked P, so as to make a good contact for the passage of the current into the rod. The current arriving from the dynamo-electric generator, or the battery, enters by this jaw into the rod, traverses the point of contact between it and the lower electrode, or abutment B (which is of copper, not carbon), and then passes on its way to the next lamp in circuit, or to the generator. The copper electrode B, which forms the negative pole of the lamp, is supported by the bracket S, but insulated from it.

Unlike the carbon rod, or positive pole, it is not consumed by the action of the current, and requires no adjustment. The positive rod must be brought up or fed in proportion as it wastes away. This is done by means of the counterpoise H. When the rod is nearly all consumed the spring clasp M comes into play and short circuits the current through the exterior tube of the lamp and past the carbon. In this way the other lamps in circuit are not affected by the stoppage of one. The insertion of a fresh carbon rod into the tube serves to start the burning of the lamp as before.

CORRESPONDENCE.

THEORY OF VOLTAIC ACTION.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In reference to the recent criticism of Dr. Exner's results in comparison with those of previous experimenters (p. 9 *ante*), I should like to draw attention to a recent paper by Herr M. Th. Edelmann, in "Carl's Repertorium für Experimental Physik," vol. XVI., describing some new experiments on the difference of potential in air of Zn | Cu, Cu | Fe, and Fe | Zn.

These metals were in the form of discs, and were supported close to one another as follows:—In a circular plane metal plate were made two equal circular openings equi-distant from its centre and in contact with one another. In these were supported the discs to be examined, flush with the underside of the metal plate, and insulated from it. The discs could thus be interchanged without altering the *form* of the apparatus. The discs could be placed in contact with one another by wires passing out of the glass shade which enveloped the whole, or they could be connected with the poles of a Daniell cell for comparison in the usual way. Their difference of potential was determined by an electrified needle, or, rather, plate swinging under their point of nearest approach. Numerous and careful precautions were taken to ensure accuracy of measurement.

The results are in close agreement with those of Dr. Exner, as will be seen from the table below, and are thus a further strong argument in favour of the chemical theory. The coincidence is the more worthy of attention because the method of experiment is so entirely different (and perhaps preferable, being more direct) to that of Dr. Exner. In the table the first column gives the ratio of the observed differences of potential to that of a Daniell cell. The second gives the ratio of half the difference of the heat of oxidation of each pair of metals under examination to that of a Daniell cell, and the third column the figures calculated from Dr. Exner's results:—

	Observed.	Calculated.	Exner.
O | Zn | Cu | O	·498 D.	·496	·514 D.
O | Cu | Fe | O	·333 D.	·318	·337 D.
O | Fe | Zn | O	·175 D.	·178	·177 D.

I may just add that there is a misprint in the paper, the difference of the heats of combustion of copper and zinc being given as 24,300 instead of 24,100 calories, but the correct value is used in the calculation.—Yours, &c.,

J. BROWN.

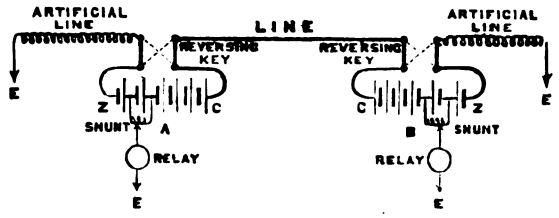
Belfast, January 28th, 1881.

DUPLEX TELEGRAPHY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The following slight modification of the system of duplex telegraphy, which Mr. G. K. Winter and I have called "double-substitution" (that is, signalling by interchanging the true and artificial lines), so as to admit of the use of the ordinary unpolarised relays instead of polarised relays, as described in our patent, No. 4,590, dated Nov. 12th, 1878, has been made by us to meet the requirements of the American Union Telegraph Company, and good results, we believe, have been obtained thereby. Perhaps the publication of it in your valuable journal will prove useful to others, if you can afford the space for it.

In applying the method of "double substitution" to unpolarised relays, we arrange the apparatus as shown in the above figure. That is, we join the receiving instrument, not to the centre of the battery, but to a point remote from the centre, and such that, when the keys are at rest, the point to which the instrument is attached is near that end of the battery which is connected to the artificial line. If the batteries at the stations A and B could be made and kept of equal power, and if there were no leakage on the line the instrument might be joined to the end of the battery instead of to a point near the end. As this can never be the case, the position of the point to which the instrument is applied is made adjustable by means of a slide resistance, the object of the adjustment being to reduce the current passing through the receiving instrument when the keys are at rest to zero. So long as the artificial line at each station is



equal to the true line no alteration in the current passing through the receiving instrument can be produced by depressing the key at the same station, and thus interchanging two equal circuits external to the apparatus. If, therefore, we depress the key at A, the key at B being at rest, no current passes through the receiving instrument at A, but the whole of the current from the batteries at A and B passes through the instrument at B except a small portion cut off by the artificial line at B acting as a shunt on the instrument. Exactly the same occurs *mutatis mutandis* when the key at B is depressed. When the keys at both stations A and B are depressed the current from the battery at A runs through the instrument at A, and the current from the battery at B runs through the instrument at B, in each case completing the circuit through the artificial line; thus each instrument is worked by means of its own battery.—Yours, &c.,

Feb. 2nd, 1881. ALEX. MUIRHEAD.

TELEGRAPH CLERKS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Although we telegraph clerks have some reason to thank you for portions of your leading article of last week, I think you are wrong in saying our agitation is for the selfish aims of senior clerks; and I am sure we were not prompted by objections to the sixpenny rate, or by wanting to steal for ourselves exclusively the profits of the telegraph service. Our view is that the whole staff should be what it was originally intended and promised it should be, and this applies to boys as well as men. Part of our scheme is that there should be a grade of boy clerks—or, rather, I should say this is part of the scheme under which we are entitled to be classified by the Act of Parliament. We do not find fault with being subordinate to the Post Office officials, but in the country especially every effort has been made to keep us down as an inferior class. The Post Office people themselves have profited by the transfer pretty considerably, whilst the claims of the telegraph clerks have been put off year after year because the service did not pay. I hope, if you take up this subject again, you will consider the overtime question and the miserable scales which the clerks have to look forward to.—Yours, &c., A CLERK OF FIFTEEN YEARS' STANDING.

1st Feb., 1881.

INDIA RUBBER, GUTTA PERCHA, AND TELEGRAPH WORKS COMPANY (LIMITED).

Directors' report for the year ending Dec. 31, 1880, to be presented at the Seventeenth Ordinary General Meeting of Shareholders, to be held at the City Terminus Hotel, Cannon-street, London, on Wednesday, 9th February, 1881, at 12 o'clock noon:—The net profit on the Company's business for the past year, as shown in the accounts, is £67,227 19s. 9d. Adding £4,278 3s. 11d. brought forward from 1879, and £774 profit on securities realised, and deducting £15,600 interim dividend paid in August, there remains a disposable balance of £56,680 3s. 8d. Of this balance the directors have added £25,000 to the reserve fund, raising it to £75,000; and they recommend the distribution of £23,400 in dividend for the last half year, being at the rate of 15 per cent. per annum, free of income tax, carrying forward £8,280 3s. 8d. to the credit of the current year. The past year's sales, both in general manufactures and in the cable department, have considerably exceeded those of 1879. A contract with the Mexican Telegraph Company of New York for the manufacture and laying of 525 miles of cable is in course of execution. Mr. Henderson, who retires by rotation, offers himself for re-election as a director.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

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THE EASTERN TELEGRAPH COMPANY.

The recent half-yearly meeting of this Company was perhaps one of the most interesting and important that has hitherto been held. It cannot, indeed, but be interesting to shareholders to hear of the continued prosperity of their property, and to have something more than a mere general idea of an increased dividend in the immediate future.

The Eastern Telegraph Company was formed about nine years ago, that is, in the year 1872, by the amalgamation or consolidation of the Falmouth, Gibraltar, and Malta Telegraph Company, the Marseilles-Algiers and Malta Telegraph Company, the Anglo-Mediterranean Telegraph Company, and the British Indian Submarine Telegraph Company. The nominal share capital is about £3,800,000. As we have more than once indicated, the policy of the board of directors has been consistent, and it is doubtful if any shareholder or indeed any person could suggest a better policy. Additional lines have been constructed as feeders to the trunk lines, the system has been extensively duplicated to obviate the loss arising from occasional faults, and although this will not make a system absolutely safe, it goes far towards perfection. In 1873, the duplicate cable between Falmouth, Vigo, and Lisbon was laid. In 1876, a duplicate cable was laid between Suez, Aden, and Bombay at a cost of £700,000, and so in other parts of the system. In addition to the duplicating the system, great efforts have been made to utilise to the utmost the carrying capacity of the lines, hence the management has constantly introduced the very best model of apparatus to be obtained, and in 1876 commenced to duplex all the important lines. The uninitiated must not confound duplexing with duplicating. The latter indicates the laying of a second and altogether separate line, the former refers to the scientific discoveries which have enabled us to send two messages in each direction upon one and the same line, thus in fact making it equivalent so far as carrying capacity is concerned to two separate lines of the olden days of cable work. The duplex system applied to the system under consideration is that devised by Dr. A. Muirhead. The first section of the system to which duplex apparatus was applied was the Marseilles-Malta section. We believe all the principal sections of the entire system are now duplexed.

It may be interesting to direct attention more especially to that portion of the report, which is given in another column, dealing with the Cape cable. We recollect the sharp reverse suffered by our soldiers in the late Zulu campaign, and the long lapse of time which took place between that reverse and our knowledge of it in England. There is no doubt that delay caused our Government to view with greater favour than they had done previously the proposition for connecting England with the Cape by means of a submarine cable. Probably a due mead of praise never has been, nor ever will be given to the directors of the Eastern Telegraph Company and of the Telegraph Construction and Maintenance Company for the energy with which they undertook and carried out all the details necessary to successfully construct and lay the cable. Their energy has been crowned with success, and so far as we can at present judge the work will prove a success commercially. That however is not our present point. Let us consider for a moment the manner in which the news of our reverse before the Boers was made known.

A line of telegraph was carried within about four miles of the actual field of battle, and hour by hour, as the evolutions were being carried out, the details of the battle were known in London. The march out in the morning, the manner in which the troops were directed, the fluctuating successes, followed by the repulse of the attack, were known almost as soon in London as on the field of battle in the Transvaal itself. The home Government no longer gropes in the dark as regards reinforcements, but knows the wishes and prospects of the commander from day to day, or, if necessary, from hour to hour. Such a feat is unexampled in the history of nations. Space, as far as communication is concerned, is practically annihilated. We notice that some of our daily contemporaries speak with admiration of the celerity of the messages passing between England and Natal, mentioning four hours as the time of transmission; but the reality is far better than this. Government messages take, perhaps, an average of *fifty* minutes only, whilst other messages do not average more than two hours. The Cape cable has indeed proved one of the best projects that the Government ever assisted, and has probably already saved the country a sum equal to the cost of its construction. Mr. Pender was perfectly justified in considering the receipts from this cable as at the present moment abnormal, but it may prove that on the restoration of quietude in South Africa a large business will be developed, arising out of commercial transactions which at present must necessarily be more or less stagnant.

The policy of the directors to have a good reserve is one that cannot fail to commend itself to those who know aught of the risks to which cable property is exposed. We should look in most cases upon 10 per cent. of the capital as the minimum reserve. There is nothing more certain than that the earnings of a cable should be divided into two portions, the first of which should go to form a sinking fund which when the life of the cable was ended should give a sum sufficient to replace such cable, the second portion would go to the shareholders in the shape of dividends. The sum periodically added to the reserve in fact plays the part of the premium paid in life insurance. The reading of the report cannot but convey the impression that England has men still able to initiate and carry on the sound if gigantic enterprises which have so long placed and maintained her at the head of the commercial world.

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THE TELECTROSCOPE.

BY MONS. SENLECQ, OF ARDRES.

This apparatus, which is intended to transmit to a distance through a telegraphic wire pictures taken on the plate of a camera, was invented in the early part of 1877 by M. Senlecq, of Ardres. A description of the first specfication submitted by M. Senlecq to M. du Moncel, member of the Paris Academy of Sciences, appeared in all the continental and American scientific journals. Since then the apparatus has everywhere occupied the attention of prominent electricians, who have striven to improve on it. Amongst these we may mention MM. Ayrton, Perry, Sawyer (of New York), Sargent (of Philadelphia), Brown (of London), Carey (of Boston), Tighe (of Pittsburgh), and Graham Bell himself. Some experimenters have used many wires, bound together cable wise, others one wire only. The result has been on the one hand confusion of conductors beyond a certain distance, with the absolute impossibility of obtaining perfect insulation; and, on the other hand, an utter want of synchronism. The unequal and slow sensitiveness of the selenium likewise obstructed the proper working of the apparatus. Now, without a relative simplicity in the arrangement of the conducting wires intended to convey to a distance the electrict current with its variations of intensity, without a perfect and rapid synchronism acting concurrently with the luminous impressions, so as to insure the simultaneous action of transmitter and receiver, without, in fine, an increased sensitiveness in the selenium, the idea of the telectroscope could not be realised. M. Senlecq has fortunately surmounted most of these main obstacles, and we give to-day a description of the latest apparatus he has contrived.

TRANSMITTER.

A brass plate, A, whereon the rays of light impinge inside a camera, in their various forms and colours, from the external objects placed before the lens, the said plate being coated with selenium on the side intended to face the dark portion of the camera. This brass plate has its entire surface perforated with small holes as near to one another as practicable. These holes are filled with selenium, heated, and then cooled very slowly, so as to obtain the maximum sensitiveness. A small brass wire passes through the selenium in each hole, without however touching the plate, on to the rectangular and vertical ebonite plate, B, Fig. 1, from under this plate at point C. Thus, every wire passing through plate A has its point of contact above the plate B lengthwise. With this view the wires are clustered together when leaving the camera, and thence stretch to their corresponding points of contact on plate B along line CC. The surface of brass A is in permanent contact with the positive pole of the battery (selenium). On each side of plate B are let in two brass rails, D and E, whereon the slide hereinafter described works.

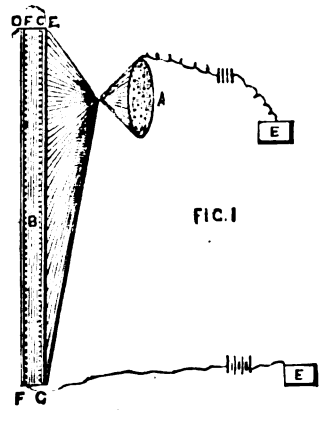


FIG. 1

Rail E communicates with the line wire intended to conduct the various light and shade vibrations. Rail D is connected with the battery wire. Along F are a number of points of contact corresponding with those along C C. These contacts help to work the apparatus, and to insure the perfect isochronism of the transmitter and receiver. These points of contact, though insulated one from the other on the surface of the plate, are all connected underneath with a wire coming from the positive pole of a special battery. This apparatus requires two batteries, as, in fact, do all autographic telegraphs—one for sending the current through the selenium, and one for working the receiver, &c. The different features of this important plate may, therefore, be summed up thus:—

FIGURE 1.

D. Brass rail, grooved and connected with the line wire working the receiver.

F. Contacts connected underneath with a wire permanently connected with battery.

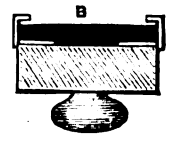
C. Contacts connected to insulated wires from selenium.

E. Brass rail, grooved, &c., like D.

RECEIVER.

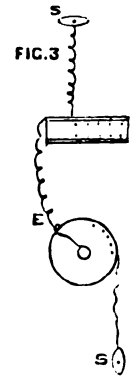
A small slide, Fig. 2, having at one of its angles a very narrow piece of brass, separated in the middle by an insulating surface, used for setting the apparatus in rapid motion. This small slide has at the points D D a small groove fitting into the brass rails of plate B, Fig. 1, whereby it can keep parallel on the two brass rails D and E. Its insulator B, Fig. 2, corresponds to the insulating interval between F and C, Fig. 1.

FIG. 2



A, Fig. 3, circular disc, suspended vertically (made of ebonite or other insulating material). This disc is fixed. All round the inside of its circumference are contacts, connected underneath with the corresponding wires of the receiving apparatus. The wires coming from the seleniumised plate correspond symmetrically, one after the other, with the contacts of transmitter. They are connected in the like order with those of disc A, and with those of receiver, so that the wire bearing the No. 5 from the selenium will correspond identically with like contact No. 5 of receiver.

FIG. 3



D, Fig. 4, gutta percha or vulcanite insulating plate, through which pass numerous very fine platinum wires, each corresponding at its point of contact with those on the circular disc A.

The receptive plate must be smaller than the plate whereon the light impinges. The design being thus reduced will be the more perfect from the dots formed by the passing currents being closer together.

B zinc or iron or brass plate connected to earth. It comes in contact with chemically prepared paper, C, where the impression is to take place. It contributes to the impression by its contact with the chemically prepared paper.

In E, Fig. 3, at the centre of the above-described fixed plate is a metallic axis with small handle. On this axis revolves brass wheel F, Fig. 5.

On handle E presses continuously the spring H, Fig. 3, bringing the current coming from the selenium line. The cogged wheel in Fig. 5 has at a certain point of its circumference the sliding spring O, Fig. 5, intended to slide as the wheel revolves over the different contacts of disc A, Fig. 3.

This cogged wheel, Fig. 5, is turned, as in the dial telegraphs, by a rod working in and out under the successive movements of the electro-magnet H, and of the counter spring. By means of this rod (which must be of a non-metallic material, so as not to divert the motive current), and of an elbow lever, this alternating movement is transmitted to a catch, G, which works up and down between the cogs, and answers the same purpose as the ordinary clock anchor.

This cogged wheel is worked by clockwork enclosed between two discs, and would rotate continuously were it not for the catch G working in and out of the cogs. Through this catch G the wheel is dependent on the movement of electro-magnet. This cogged wheel is a double one, consisting of two wheels coupled together, exactly similar one with the other, and so fixed that the cogs of the one correspond with the void between the cogs of the others. As the catch G moves down it frees a cog in first wheel, and both wheels begin to turn, but the second wheel is immediately checked by catch G, and the movement ceases. A

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catch again works the two wheels, turn half a cog, and so on. Each wheel contains as many cogs as there are contacts on transmitter disc, consequently as many as on circular disc A, Fig. 3, and on brass disc within camera. Having now described the several parts of the apparatus, let us see how it works. All the contacts correspond one with the other, both on the side of selenium current and that of the motive current. Let us suppose that the slide of transmitter is on contact No. 10 for instance, the selenium current starting from No. 10 reaches contact 10 of rectangular transmitter, half the slide bearing on this point, as also on the parallel rail, communicates the current to said rail, thence to line, from the line to axis of cogged wheel, from axis to contact 10 of circular fixed disc, and thence to contact 10 of receiver. At each selenium contact of the rectangular disc there is a corresponding contact to the battery and electro-magnet. Now, on reaching contact 10 the intermission of the current has turned the wheel 10 cogs, and so brought the small contact O, Fig. 5, on No. 10 of the fixed circular disc.

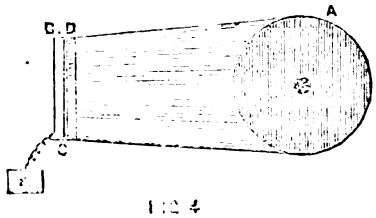

FIG. 4

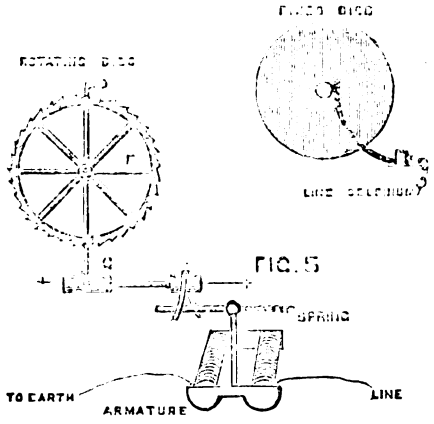

FIG. 5

As may be seen, the synchronism of the apparatus could not be obtained in a more simple and complete mode—the rectangular transmitter being placed vertically, and the slide being of a certain weight to its fall from the first point of contact sufficient to carry it rapidly over the whole length of this transmitter.

The picture is, therefore, reproduced almost instantaneously; indeed, by using platinum wires on the receiver connected with the negative pole by the incandescence of these wires according to the different degrees of electricity we can obtain a picture, of a fugitive kind, it is true, but yet so vivid that the impression on the retina does not fade during the relatively very brief space of time the slide occupies in travelling over all the contacts. A Rhumkorff coil may also be employed for obtaining sparks in proportion to the current emitted. The apparatus is regulated in precisely the same way as dial telegraphs, starting always from first contact. The slide should, therefore, never be removed from the rectangular disc whereon it is held by the grooves in the brass rails, into which it fits with but slight friction, without communicating any current to the line wires when not placed on points of contact.

MEASURING ELECTROMOTIVE FORCE.

Coulomb's torsion balance has been adapted by M. Baille to the measurement of low electromotive forces in a very successful manner, and has been found preferable by him to the delicate electrometers of Sir W. Thomson. It is necessary to guard it from disturbances due to extraneous electric influences and the trembling of the ground. These can be eliminated completely by encircling the instrument in a metal case connected to earth, and mounting it on solid pillars in a still place. Heat also has a disturbing effect, and makes itself felt in the torsion of the fibre and the cage surrounding the lever. These effects are warded of by enclosing the instrument in a non-conducting jacket of wood shavings.

The apparatus of M. Baille consists of an annealed silver torsion wire of 2·70 metres long, and a lever 0·50 metres long carrying at each extremity a ball of copper, gilded, and three centimetres in diameter. Similar balls are fixed at the corners of a square 20·5 metres in the side, and connected in diagonal pairs by fine wire. The lever placed at equal distances from the fixed balls communicates, by the medium of the torsion wire, with the positive pole of a battery, P, the other pole being to earth.

Owing to some unaccountable variations in the change of the lever or needle, M. Baille was obliged to measure the change at each observation. This was done by joining the + pole of the battery to the needle, and one pair of the fixed balls, and observing the deflection; then the deflection produced by the other balls was observed. This operation was repeated several times.

The battery, X, to be measured consisted of ten similar elements, and one pole of it was connected to the fixed balls, while the other pole was connected to the earth. The needle, of course, remained in contact with the + pole of the charging battery P.

The deflections were read from a clear glass scale, placed at a distance of 3·30 metres from the needle, and the results worked out from Coulomb's static formula,

$$C\,a = \frac{4\,m\,m'}{d^2}, \text{ with } O = \sqrt{\frac{\Sigma \frac{p}{g} r^2}{C}}.$$

In M. Baille's experiments, $O = 437^3$, and $\Sigma p\,r^2 = 32171{\cdot}6$ (centimetre grammes), the needle having been constructed of a geometrical form.

The following numbers represent the potential of an element of the battery—that is to say, the quantity of electricity that the pole of that battery spreads upon a sphere of one centimetre radius. They are expressed in units of electricity, the unit being the quantity of electricity which, acting upon a similar unit at a distance of one centimetre, produces a repulsion equal to one gramme :—

Volta Pile	0·03415	open circuit.
Zinc, sulphate of copper, copper	0·02997	,,
Zinc, acidulated water, copper, sulphate of copper	0·03709	,,
Zinc, salt water, carbon peroxide of manganese	0·05282	,,
Zinc, salt water, platinum, chloride of platinum	0·05027	,,
Zinc, acidulated water, carbon nitric acid	0·06285	,,

These results were obtained just upon charging the batteries, and are, therefore, slightly higher than the potentials given after the batteries became older. The sulphate of copper cells kept about their maximum value longest, but they showed variations of about 10 per cent.

LITERATURE.

Guide to the Correction of Errors in Code Telegrams. Third Edition. [Published by the Eastern Telegraph Company. Price 1s.]

The new edition of this Guide contains not only a mere list of words telegraphically alike or somewhat alike, but shows how in certain cases mistakes may and do arise. These sources of error were discussed by Sir James Anderson and others in early numbers of *The Electrician*, part of such observations being incorporated in this Guide. It is hardly fair to blame a company for the incorrect transmission of a message which contains words or figures conducing to incorrectness rather than otherwise. The repetition of a message is a direct loss, inasmuch as it blocks the line as effectually as an original message. The companies for their own sakes will endeavour to transmit as correctly as possible, and this Guide is issued that the telegraphing public may be able by a very little trouble to aid the companies in their efforts. When we are told that in 1,615 repetitions, 428 were found to contain words identical telegraphically with 428 entirely different words, the conclusion is plain that such words should be avoided. Surely the limits of language allowed are wide enough to obviate the necessity of using such words as "abacist," "abacus," "abana," &c., identical in telegraphic signals with "abatrist," "abatrus," "abated" or "abetted," &c., respectively. We believe the publication of such a Guide requires only to be known to ensure its general use.

The Guide also contains maps of the Eastern Companies European, and Extra European lines and connections, as well as tables showing the differences in longitude of various important business centres.

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CABLE-LAYING IN GUIANA.

BY J. MUNRO, C.E.

(CONCLUDED FROM PAGE 106.)

At the mayor's house we saw abundance of this gold, which had inflamed the telegraphists, cigar box after box of shining yellow dust, nuggets like pebbles, and large irregular lumps of the solid metal, with the red earth still clinging to them. There was something very catching in the gold fever; but luckily we had our legitimate work to attend to, which could not be delayed.

By the help of a small steamer, the "Serpent," belonging to the French Government, we paid out the shore end over the shallow mudflats from barges. On Sunday, July 5, when the barges could go no further, a gang of a hundred Arab convicts, with manacles on their ankles, and wide-brimmed palm leaf hats, to ward off sunstroke, were ordered to enter the mud and land the cable. They at once plunged into the foul, slimy fever bed, but the consequences to some of them were fatal, as we afterwards learned. They dragged the heavy black cable up the shore through the bananas and castor oil plants, and landed the end in the telegraph office. The entire length between Para and Cayenne was then crucially tested, and found to be sound, whereat there was general rejoicing. The engineer-in-chief for the contractors at once despatched a telegram to them in London, conveying the welcome intelligence "Para to Cayenne Section completed—Insulation superb;" and the chief electrician for the Telegraph Company followed it up by another to his employers equally gratifying, "Para to Cayenne Section completed—Insulation perfect." And next morning, no doubt, the various shareholders concerned in the matter would also feel a thrill of satisfaction at reading in *The Times* these magic words, "Insulation superb," "Insulation perfect." When this official business had been done the Governor of Cayenne arrived, and messages of mutual congratulation on the felicitous occasion were exchanged between him and the Governor of Para. Then a set of thirty mock messages were sent from Cayenne and received by Para, in accordance with the terms of contract, and the cable was declared open for public traffic.

It only remained for us now to get away again without loss of time. On Monday morning we landed the electricians who were to be left at Cayenne to co-operate with the ship during the laying of the Cayenne to Demerara section. Duxbury, Jericho, and Co.'s expedition to the gold-mines was then setting sail. It was composed of a large unwieldly piroque filled with boxes, kegs, and crates of provisions, negroes and negresses, all jumbled together, with St. Clair, the miner, perched upon the top under a blue umbrella, and Jericho's brother standing in the prow, looking out ahead. We waived adieu to them, not without a feeling of regret. In the evening all who were going with the "Hooper" embarked in the pilot's cutter at the end of the pier, and set sail for the "Hooper," leaving our shore friends behind us among the motley crowd of parti-coloured natives, Moor, Arab, Indian, and negro. In the declining light of evening the verdure on the little rocky hill of Ceperou took a more vivid green, the sea was glassy smooth, and the crests of the palm trees seemed painted on the still amber-coloured sky. As we sped away before the breeze over the tawny water, Duxbury, who was going on with us to Demerara, struck up a negro chorus, in which we all joined. In time the sun went down, and we could see as we neared the "Hooper" the sails of the gold hunters far up the coast like a quivering speck on the golden horizon. "Good bye, Cayenne, may we never see you again," said the captain, as we put out to sea. But his fervent prayer was not destined to be granted.

We returned to the T piece for the purpose of laying on to Demerara, but on getting there and picking up the sealed arm we were unexpectedly disappointed, for on testing the cable it was found to be faulty. It would occupy too much space to relate our subsequent experiences with the cable, but some of these were so singular that they deserve to be mentioned. We returned to Cayenne and tested the cable from there, locating the fault about 120 miles from Para. Then we returned to Para and tested again, locating the fault in a similar position. The repairing ship, "Great Northern," was then got ready for sea to cut out the fault, and the "Hooper" was ordered to England because it was feared that a considerable portion of the cable remaining on board was unfit to be laid, for several faults had developed in it. The writer took part in the repairing on board the "Great Northern." The fault, located at about 120 miles from Para, was no sooner extracted than others were found still to be present; and no less than five "bad" faults were cut out before the cable was repaired, a process which occupied us the better part of three months. The strangest thing about three faults was their cause; they were indisputable fish bites, but it is hard to name the fishes which made them. In all of them the strong iron wires of the sheathing were forcibly displaced and bent, and in several of them we found splinters of the fibrous teeth of the animal, and pieces of decomposed dental matter.

They were found over two or three hundred miles of the cable, and later experience has shown that the depredators, whatever they are, frequent the whole coast of Guiana, since similar faults have subsequently been extracted from the whole line of cable between these places—a cable which, chiefly through their ravages, is now lying useless on the bottom, an instance of money literally thrown into the sea. Whether the cable was bitten by sharks as it sank, or by the saw-fish or some other of the voracious fishes known to haunt the coral reef which fringes that coast, is not yet a settled point; but the latter supposition is the likelier, inasmuch as the cable has, I believe, been bitten since it has been lying on the bottom.

Owing to the neighbourhood of the coral reef we found the grappling for the cable very difficult work, the coral rocks catching in the grapnel and breaking off the iron flukes. Off the Para mouth of the Amazon the cable came up entirely coated with barnacles at some places, and at others thickly overgrown with sea-weeds and corallines, although it had only been submerged a month. These groves of submarine vegetation were sometimes very beautiful, more delicate than the frailest mosses and ferns, and often stained a deep orange, red, or blue. Some were entirely transparent, and resembled filaments of glass. Through the wet meshes of these sea-blooms crawled many curious star-fishes, crabs, and water-beetles, some transparent like the plants, others tinted with amethyst blues, scarlets, and yellows, and many shaggy themselves with a parasitic growth of the same plant-life.* The forests of the Amazon have now been well explored, but there is yet a rich and virgin field for the naturalist in the litoral zones of her estuary waters, and our cable-lifting experience suggests a novel mode of dredging them.

One day, towards the end of our repairing operations, we "spoke" with Cayenne, and learned from Jericho that the gold mining expedition had been ill-fated. The fever was raging at the diggings, a hundred and forty diggers had died from its effects during the past month, and St. Clair was then lying in the hospital at Cayenne in a very critical state.

The great claim which was supposed to contain a fortune in its soil had, we were informed, turned out to be barren, from having been worked before, and for the present the gold mines had been practically abandoned.

On completing the repairs of the Para to Cayenne section, the "Great Northern" went back to Para, and all those of the "Hooper" who had been left with her returned home. Next year the "Hooper" again visited Cayenne and layed the Demerara section; but chiefly owing to the persistent attacks of the curious fish with the taste for submarine cable, neither of these Guiana cables has been kept in practical operation. They are fast becoming fossilised among the grey globigerina ooze and coral of the sea-bottom, and they will probably, in the remote future, cause some geologist of the coming race to ponder much as to their origin when he chips them out of the chalk quarry in which they are embedded. Perhaps, however, they will be repaired ere long. The Hooper Telegraph Company which laid them has long since been changed, and the "Hooper" herself is now engaged either in carrying rice from Madras or cattle from North America.

* Some further account of these creatures is to be found in *Nature*, Feb. 25, 1875.

THE EASTERN TELEGRAPH COMPANY (LIMITED).

The seventeenth half-yearly ordinary general meeting of the Eastern Telegraph Company (Limited) was held on Thursday, the 27th January, 1881, at the City Terminus Hotel, Cannon-street, London, under the presidency of John Pender, Esq., M.P.

The SECRETARY (Mr. George Draper) having read the notice convening the meeting and the minutes of the last meeting, which were confirmed,

The CHAIRMAN said: Gentlemen, you have had the published report and accounts in your hands for some days. The accounts are very full in their details; but, as usual, I will make a few remarks on them before putting the motion for their adoption to the meeting. The net revenue of the six months ended the 30th of September, 1880, including £11,700, the half year's dividend on the Eastern and South African Company's shares, amounted to £268,128 15s. 5d. against in the corresponding half of 1879 £229,095 5s. 8d., or an increase of £39,033 9s. 9d. The traffic receipts for the six months under review amounted to £256,246, and for the corresponding half year to £228,698, or an increase of £27,548. The ordinary expenses of the company amounted to £68,039 12s. 4d., against in the corresponding half of 1879 £60,538 3s. 1d., or an increase of £7,501 9s. 3d. This increase, on the face of it, looks large, but when the different accounts of which it is composed are gone into, it will be found that the main item of increase is in the maintenance and renewal of land lines, instruments, and electrical appliances, amounting to £4,423. Included in this amount is a sum charged for replacing the whole of our Egyptian land lines with iron, instead of wooden poles. The expense, though heavy for the time being, will, probably, not continue for more than another year, and will save a considerable outlay in the future maintenance charges. As you are aware, gentlemen, wooden poles in Egypt are not to be depended on, and, in fact, the erection of wooden poles is more a thing of the past; but this is a line bought by the present Company, and, therefore, we used the wooden poles as long as we could with advantage; but we are now replacing them by degrees with iron poles, and making a thoroughly efficient system. The line is from Alexandria and Cairo to Suez, and it is an important link, connecting our Indian and trans-Indian system with the Mediterranean system. In this half year's accounts there are also several exceptional items, the first of which is loss on the realisation of the Egyptian Government debt, £772. Now, that is an amount which, I am glad to say, is a small loss, as compared with what appeared at one time to be rather a considerable loss, staring us in the face. During the late Khedive's rule in Egypt (he was a man, as you know, of very considerable enterprise), the Eastern Telegraph Company's revenue benefitted very largely—in fact, in a year the telegraphing for the Khedive himself in his private capacity, as also for his Government, amounted to something like £17,000 or £18,000. Well, we gave him credit (he got credit from a great many other people besides us), and the result was that he owed us at one time something like £17,000. We have now got that account settled. We have received against it such securities as we could realise to-day very satisfactorily, but taking into account the bringing home from Egypt of that amount, the loss by exchange would be about £770. I think, however, that we can recoup that from the enhanced price we shall obtain for the securities, as they stand very favourably in the market. I, therefore, look on that as a very satisfactory ending to what appeared at one time a very bad piece of business [hear, hear]. We may tell you that the securities we hold we have such perfect confidence in that instead of realising them, as we get a good interest on them, we have taken them as part of our reserve fund. The interest charges amount this half year to £340 12s. 6d., against a credit in the corresponding half year of £233 10s. 1d. This is the amount we have had to pay on advances pending the completion of purchase of £390,000 in Eastern and South African Telegraph Company's shares, against which, as is shown in the accounts, we have received a dividend of 6 per cent. Foreign agencies show an increase of £112 10s. 2d. That is, of course, a varying item. A further increase of £1,200 is also accounted for in maintenance ships reserve fund, to which we carry this half-year £3,200, against £2,000 in September, 1879. This sum, although a charge against revenue, at the same time exists as a reserve fund, and therefore it gives strength to the Company, and is not money thrown away. The extraordinary expenses amount this half year to £30,476 7s. 2d., against £19,140 11s. 8d. in the corresponding half year, or an increase of £11,335 15s. 6d., the details of which are shown in the published accounts under Abstract C. I may give you the particulars:—Refitting and repairing the screw ship "Chiltern" (after deducting £5,000 for improvements charged to the cost of the ship), £1,876 16s. 5d.; expenses of screw steamer

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"Chiltern," engaged preparing for and effecting repair of the Porthcurnow and Lisbon cable, including one month in dock, £10,392 9s. 8d.; cable expended on repair of Porthcurnow and Lisbon cable, after deducting value of cable recovered, £10,906 9s. 4d.; expenses of the screw steamer "John Pender" at sea for 23 days proceeding to her station in Suez, in harbour remainder of six months, £4,775 2s. 11d. From that you will observe that it is no joke when cables break to have large steamers employed to repair them. The expenses are necessarily very considerable. The expenses of the screw steamer "Retriever" in repairing the Ithaca-Santa Maura cable, proceeding to various stations, adjusting numerous shore ends in the Levant, effecting small repairs, and at her station (Syra) for two periods aggregating 104 days, £2,416 12s. 11d. When we purchased that ship I think I stated to you that it would in all probability effect a saving of £3,000 or £4,000 a year. There is no doubt it does effect that saving, because if we had to employ one of the larger ships to do the work which this little ship has done, you would have been at an expense of £3,000 or £4,000 a year more than she has cost us; so that the "Retriever" has been a most valuable ship in doing small repairs, always incidental to cables laid in shallow waters. I may say that that ship has pretty nearly paid for herself by the saving she has effected. I think I have given you the principal details of the increase in the extraordinary expenses. I might have troubled you with a great many more, as I have the particulars here in my hands; and if any question is put relating to them, I shall be quite prepared to answer them. But there is one fact I would more particularly draw your attention to as being the cause of the expenditure of so large a sum for repairs this half year. I think it was just before the close of the meeting which took place six months ago, before we had left this room, but after the meeting, we learned that our cable in the Atlantic, the Vigo-Lisbon cable, which had been in the sea ten years, had been picked up from a depth of 2,000 fathoms. Well, I may tell you that that interruption gave rise for some considerable time to a great deal of discussion, and a very great deal of interest on the part of your board. I felt, and there were others who entertained a similar opinion, that as the repairs for that year had not been heavy, it was a most important problem to solve as to whether it would be possible to pick up from the bottom of the sea, from a depth of 2,000 fathoms, a cable which had been ten years in the water. We believed that if this could be done it would give a wonderful value to the whole of our property, because we felt that if we could pick up a cable from 2,000 fathoms there was no question of picking up and repairing cables at any number of fathoms under 2,000. The work was done, and done in a way that certainly did surprise many of us; but nevertheless it established the fact that a cable can be picked up from a depth of 2,000 fathoms, even though it has been in the water ten years. Unfortunately that cost us about £20,000. But if you distribute £20,000 over our capital as a whole, it is a small percentage compared with the enormous increased value it has given to the whole of our telegraph system. Unfortunately that cable has broken again; and it is in waters which are so far as we can see dangerous. Still, we have not the least hesitation in saying that we believe before we meet you again we shall be able to report something favourable of the cable. That expedition took a very large portion of the expenses of repairing during the last six months. When I addressed you in July the accounts then before you were up to the end of the financial year, at which time we put to the reserve fund the sum of £78,000. The repairs during that year amounted to one per cent. on the capital. The accounts now presented are for the half year ending the 30th September, and I may add the poorest half of the year as far as revenue is concerned. Still, we have had an increase, but I am sorry to say the half year has been made poorer still by the large amount for repairs, which I may just state amounted to 1¼ per cent. per annum on our capital. I hope during the current half year we shall be able to do with less repairs, and of course with less repairs we shall have an increased revenue, and I hope earn an increased dividend. The interruptions to the cables are, of course, entirely beyond our control. We may do something in economies, but when a cable breaks there is only one way of dealing with it, and that is to get it repaired as soon and as inexpensively as possible. At the present moment three of our important cables are broken. We received intelligence only this morning that one was broken; but it gives us very little thought beyond the fact that it will take a little time and some expense to repair it. It is a very great calamity when our cables break, but still time was when if a cable broke we thought it was lost entirely. It is not so now.

Sir JAMES ANDERSON: It is only five miles from the shore—the Vigo breakage.

The CHAIRMAN: Yes, and I may mention, while speaking on this subject, that the importance of having duplicated and duplexed the system must be apparent to every gentleman I am addressing [hear, hear]. Had we not had the foresight to do that we should now have been in an unsatisfactory state with our present breakage, but we have done it, and have still maintained a moderate dividend. Having now got our system in perfect order I think we may fairly, with an increase of trade, look forward to increased dividends. That is my impression, but everything turns on repairs and the expenses of repairs.

There is a considerable increase upon our general traffic, and with the improvement of trade there is no doubt that that will largely increase; but I think it is right to mention that upon our Egyptian traffic, which at one time was very considerable, there is a decrease of about £7,000, but there are several reasons to account for this. In the first place, since 1876 we have adopted the "word rate," which enables merchants to codify their messages so as to put a very large amount of matter in a very few words. In the second place the present financial affairs of Egypt do not necessitate, as they did in the days of the late Khedive, the very extended telegrams which were continually passing over our lines. I may add that, while there is a smaller income, there is a larger number of messages compared with the very long messages which used to pass over our lines, but with the improved position in the financial condition of Egypt, and the generally improving development of trade, we are hopeful that we shall see a better return from that country. At the same time it is right to mention another cause of the failing of our Egyptian traffic. For some years, as you are all aware, we had to work the land lines between Alexandria, Cairo, and Suez, from which we derived a considerable amount of traffic—something like £4,000 a year. That has also added to the falling off in the Egyptian traffic, because the Egyptian Government now work those lines themselves, and consequently we have only our own land lines for the purpose of our Indian and trans-Indian messages; but in mentioning this I may state that as Egypt is now assuming a position of a more progressive character, I believe we shall have an increased traffic with that country which may bring our Egyptian traffic shortly up to something like what it used to be.

During the autumn I visited several of our important stations in the Mediterranean and the Levant. I went to Constantinople, Athens, Rome, and France. I had interviews with all the telegraph ministers, and with the Foreign Ministers, and, in fact, with the ruling powers. I have always been under the impression that we ought, as far as possible, to give our system of telegraphy something of an international character. I wished to enlist the sympathy and support of all these countries, and I believe that to a very large extent we have succeeded in securing that sympathy and support. I had on all hands an expression of perfect confidence in the company, not only for secresy (which you are aware is a very important element in telegraphic communication in those parts) but for the accuracy and speed with which the messages were transmitted. These points were all appreciated to a degree which I can only illustrate by stating that when any important message was required to be sent it was sent over our system in preference to any others. I can give you no better evidence of the position which our Company holds in these parts than that illustration of the confidence shown in us by these powers. There was another matter which I was very pleased to see. I assure you that as an Englishman, and as the President of this important system of telegraphy in these parts, I was proud of our establishments. Our young men would do credit to any service, and I question if, taking the officers from the principals to the junior clerks, there is any system so well served. I don't believe any system in the world even equals ours—certainly I have never seen anything to surpass the way in which our business is conducted.

At the last half-yearly meeting there was a good deal said about the dividend, and there was a desire on the part of my friend, Major Leslie, to move a resolution to increase the dividend. That was the "fat half year," or rather it was the termination of the financial year; but this is merely an intermediate period. In July, when we next meet, it will be the close of our financial year, and therefore the richer and better part of the year. In the meantime, as you are aware, we have paid you the usual rate of 5 per cent., and if in the next half year the accounts show that a bonus upon that can be paid, depend upon it it will be more satisfactory and more pleasant to your board to declare it than it will be for the shareholders to receive it. It is our object first to maintain such a service as will show that we are doing our duty to the public; and our second object is to secure such a dividend for our shareholders as we think they are fairly entitled to receive, always looking to this fact that that dividend should have something of a permanent character about it [hear, hear]. With our increasing the reserve fund, as we are doing, I feel confident that our system will be considered by the investing public as one in which they may invest with confidence, and that is what your board have very much at heart, namely, to give a permanent character to these companies, as a means for the investing public to secure a fair, if not a large dividend. Gentlemen, with these remarks I beg to move the following resolution:—"That the report and accounts of the Directors to 30th September last, now submitted, be and they are hereby received and adopted."

The VICE-CHAIRMAN (the Marquis of Tweeddale): I beg to second that.

Mr. MARCUS: Before that is put I should like to make a few remarks. The chairman has given us a very good report of our property, and it must be very satisfactory to every shareholder in the room, but there is one matter, in which we have a very large interest, on which very little has been said—I refer to the South African Company. In the first place we have no account at all as to the takings of that company for the six months, as is usual in most telegraph companies. The second point is that there is no account of the expenses of the company during that period. And, independently of this, I cannot see the object of the new company continuing as they are. We hold the principal interest in the company, and of whom or what does the company consist? The seven directors; they manage everything, they audit the accounts. The shareholders know nothing, except the amount of dividend that has been declared for the half year. Beyond that we know nothing. There are two reserve funds—£2,500 for maintenance ship and hulk, and £25,000, a general reserve and renewal fund. I may be wrong, but (I am not speaking in a feeling of hostility to the directors) I cannot see why we cannot amalgamate instead of keeping two separate accounts. The directors may have some object in doing what they are doing, but I cannot see it.

Mr. JOHN NEWTON: I am very glad to see the alteration you have made in the account by including this Abstract C, giving the cost of various repairs and alterations in the cables. While we have spent in the past half year a larger sum than in any previous half year, except in one case, it must be very satisfactory to see that the largest proportion has been expended to prove that cables have a longer life than ten years. Within the last month the chairman of one of the companies has announced something to that effect: that a telegraph cable has only ten years' life. It is important that we should have information as often as possible to the contrary. By establishing, as you have done, the fact that these cables have a longer life than has been supposed, you do away with the necessity of having these large reserve funds. I must say that you could have declared 6 per cent. in the past six months. Another point in the accounts which shows an alteration is the loss on the realisation of the Egyptian Government debt—£772. It is a small item, but it has established a different principle to that which you established in 1876, when the loss you made on the securities you realised was charged against the interest received on the investments of the reserve fund. On a former occasion, too, when you made a gain it did not go to revenue, but went to the benefit of the reserve fund. Therefore, I hold that instead of charging this to revenue it should be charged to the reserve fund. You should adopt the same principle in either case.

Dr. WALLER: In common with other gentlemen at the meeting I feel, sir, that your very lucid and satisfactory speech to-day may, at all events, be considered very cheering. It is true, sir, there are one or two matters that may alarm us a little, and one of those is the very large expenditure of

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over £20,000 in the repairs of cables. Now, sir, you said very sincerely that that was no joke, and indeed I think that the person who would look on it as jocular would have a very peculiar sense of the humorous [laughter]. I don't think any of us, notwithstanding that encouraging laugh, so regard it. I hope the laugh was at me, and not at the £20,000. At the same time, I think, sir, that we may derive some consolation from the matter. One consoling feature is, that what has hitherto been empirical has now been established as a very extraordinary fact—that you may raise a cable at such a depth as 2,000 fathoms. That is a very satisfactory feature, for I suppose that is somewhat about the maximum depth a cable would be found anywhere. Therefore, for the future, instead of looking on these fractures as the loss of a cable, they will mean simply the reparation of a cable. These contingencies are entirely out of human control. It is quite impossible to speculate on the loss of a cable. If we wanted any proof of that it is this—that this cable, just repaired, and, as I understand from the report, laid on a less unequal bottom, has, nevertheless gone; and on that point I am disposed to ask if you could give us any reasonable account for that circumstance, for it does seem very strange that this cable, relaid on new ground supposed to be much less unsuitable for a cable, has, nevertheless, gone. I hope it was not from any imperfection in the cable. That is the only thing that I shall say on that.

Now, sir, with regard to Egypt, I confess that of the three grounds you have given for the diminution in our revenue in that quarter, but one seems at all hopeful. Speaking geographically as well as politically, I do not think we may expect any increase of revenue from the inland portion of the telegraph lines that are now in the hands of the Egyptian Government. I may be quite wrong, but I do expect this from the analogy of the postal service—that though for a time the system of stenography, if I may say so, applied to telegraphy, has very much reduced our balance, I think from the analogy of the postal service we may expect to get an increase. However, that is not a large item. To speak of the dividend, I entirely concur with what has fallen from you, and I trust that the shareholders will take the same view of it—that there is nothing so important, either in railways, in one of which I am interested, and have great experience, on this class of property as to keep to an equable and permanent dividend. I know it is a very *ad captandum* argument, that each half year should bear its own losses and reap its own profits, but I am sure that that argument is a mistake, and that no merchant would act up to it. I am sure he would not get a better character because he had one carriage one half year and two in another. Such a policy agitates shareholders' minds, and it gives rise to perpetual Stock Exchange bargaining—I don't know what to call it. Men try to discount the rise and fall, whereas if you kept to a moderate and permanent dividend you make your stock always respectable [time, time] and your dividend so likewise. But, sir, I must agree with you, too, that if at any time you do see your way to an increase to the shareholders' profit it should be by way of bonus, as the increase may only be of a temporary character. When we look at that large expenditure of £20,000 I would strongly hope that nothing will induce the shareholders to seek to get a larger dividend till they have formed a very large reserve fund.

Major LESLIE: As the mover of a resolution on the subject at the meeting last July I think it my duty to speak on the principle of increased dividends. I anticipated that this year our usual rate would be exceeded, but I do not think any exception can be taken to the conduct of the management by the directors on this occasion. There is, however, one principle enunciated by the chairman against which I think we should guard. He proposes that we should make our concern a very safe 5 per cent. dividend-paying undertaking, and put a large amount to the reserve fund.. At the present time I think an excessive sum is put to the reserve fund, which on some future occasion may be confiscated; and I think that the present proprietors have a fair right to the profits now earned. I do not say this year, but after what the chairman said I look forward next half year to having an increased dividend. I have a resolution to move on that later on—not that I have any fault to find with the directors; and I acquiesce, as the mover of a former resolution, in what the directors have now done.

The CHAIRMAN: I will reply first to Mr. Marcus. Mr. Marcus, in his remarks on the South African Company, made a mistake in the first place in supposing that the directors were the auditors of that company.

Mr. MARCUS: I did not say so.

The CHAIRMAN: I thought you said that the company was managed and the accounts audited by the seven directors.

Mr. MARCUS: I said that the accounts of that company should be published, as in the case of the other companies.

The CHAIRMAN: I may mention how the South African Company was formed, and what I state now I have stated at these meetings on more than one occasion—that we were most anxious this important work should be done, but we were equally anxious that it should not prejudice in the slightest degree the Eastern Company's property in any way. We, therefore, made arrangements with the Telegraph Construction Company to run something more than half the risk incurred in laying down that cable. If we had gone to the public, and asked for an increased capital in the Eastern Company, it would have put our shares down probably 50 per cent. We knew that there would be many objections to such a large risky extension as this; and we thought if we could get this work carried out, which was so valuable and important in a national point of view, and at the same time make it a feeder to the Eastern Company without risking in any way its capital or interest, that it was a wise policy to follow. We did not believe there was to be a very large return from that company. There is a very considerable revenue at the present moment, but you must bear in mind it may be springing out of the war. Therefore I think, looking at all the gains and all the profits that are accruing from that company to the Eastern Company, the Eastern Company having run no risk, and having what I believe a good property in hand, we have acted rightly; but I think until we come to something like normal times it would be just as well, perhaps better, for the interests of the Eastern Company altogether if we do not say too much about the South African Company at present. We give you in our accounts what we are receiving, and we take very good care that out of the income of the South African Company we are lessening our risk every day in that company. I may not live long enough to see it, nor all of the gentlemen now at the board; but if those who follow us maintain our present policy, I hope that the South African Company will be ultimately an appanage of this Eastern Company, without having cost us much. That was our object in dealing as we have done with the South African Company. We were bound to have a separate company and a separate organisation, or the thing could not be carried out; but the more that it is looked into I think it will be seen that there should be the utmost confidence in the board, and the Telegraph Construction Company in this matter. The Government saw, and appreciated the feeling, that your interests were our first thoughts in connection with that matter. I hope that explanation is satisfactory to Mr. Marcus. Another remark was made in the room, that the interest of the reserve fund should go to the reserve fund. I am quite prepared to admit this. With respect to the remarks of Dr. Waller, he has said that we have spent a large sum on these repairs. That is quite true; but there was an experiment made by another company which cost them about £80,000, and they were not successful. We have been successful, and our experiment cost us £20,000, and I hope it has given increased value to our whole property. At all events since that occurred there has been a considerable advance in the value of the property. As to Egypt, there is no doubt that with an increase of trade there will be increasing traffic there. Telegraphy has got into the position now that it is an important factor in politics and in commercial and social life, and there are very few men now who put their hands to a letter when they can telegraph. That is going on, and from that we must derive benefit. Now, as regards Dr. Waller's remark about the new cable, Sir James Anderson has put the following remarks in my hand, and as he is a thoroughly practical man, and knows the bottom of the sea almost as well as he knows the streets of London, he can tell you much better than I can all about this matter; and, therefore, I will read what he has written. Sir James says:—"We consider that the new cable has broken just upon the edge of a bank, where the water deepens suddenly, and as there was an increasing gale while the ship was approaching that spot, and the cable had to be buoyed until the weather improved, we are of opinion that this part of the cable, which is new, will be repaired inexpensively."

Sir JAMES ANDERSON: At a small expense, I hope.

The CHAIRMAN: But at the present time, as we are not dependent on that, and as the weather is an important feature in the repair of cables, we are waiting till better weather comes before we go to the expense of sending out a ship, which might otherwise have to go backwards and forwards to repair this breakage.

Dr. WALLER: I understand that there is no defect in the new cable.

The CHAIRMAN: No. I will say to Major Leslie that he is entitled to speak almost more than any one connected with this system of telegraphy. He has always been just and generous. He has always appreciated the work of the directors, though it was sometimes adverse to his own interests. I mean in this way: that he thinks on the large amount he holds in this Company he ought to have an increased dividend; but as I have said to the Major before, I think a certain 5 per cent., with the prospect of a bonus, better than 8 per cent. one year, and 3 per cent. in another. As to the reserve fund our capital exceeds £5,000,000, and £300,000 is not a large reserve fund against a capital of £5,000,000. If we had £500,000 reserve we should be able to replace any cable without going to the public for the money, and I think the more secure we can make ourselves in that respect the better we guard the interests of our shareholders. With these remarks I beg to move the adoption of the report. It has been seconded by the Marquis of Tweeddale.

The motion for the adoption of the report was then put to the meeting, and carried unanimously.

The VICE-CHAIRMAN (the Marquis of Tweeddale): Gentlemen, it is my agreeable duty to propose the next resolution, which is:—"That John Pender, Esq., M.P., who now retires, be and he is hereby re-elected a director of this company." I do not think this resolution will require any words of recommendation from me. You all know that Mr. Pender is a man of great ability, energy, and commercial knowledge, and I think everyone here who is at all acquainted with him and has attended former meetings is aware that he has devoted his knowledge, energy, and ability to the furtherance and advancement of the interests of this Company with eminent success. I, from my personal experience, having been associated with him from the first establishment of this Company, can testify to the manner in which he has never on any occasion spared himself any trouble in the interests of the Company. Whether the Company have required his services in dealing with home Governments in long and delicate negotiations, or in proceeding to distant parts of the world—Constantinople and other places—he has always conducted the duties he has undertaken with eminent skill, zeal, and success. Under these circumstances I hope you will pay him the graceful, and, I venture to think, well-merited compliment of unanimously re-electing him on this occasion.

The Right Hon. W. N. MASSEY, M.P.: I have great pleasure in seconding the motion of my noble friend. The claims of Mr. Pender on the proprietors of this undertaking are so well known that it would be unbecoming on my part to urge anything beyond what has been stated by the Marquis of Tweeddale. I do not suppose there will be a single dissentient voice to the re-election of Mr. Pender.

Mr. RIXON: If you will permit me to add one word it would be to convey an expression of our sympathy to Mr. Pender in his late bereavement in the death of his son. I think, coming from this meeting, it would be most acceptable, not only to himself, but also to his family. As you are perfectly aware, the illness of which Mr. Henry Denison Pender died was while he was out inspecting your property. He was a most able young man. I shall not say anything further on this subject than that I happened to know him for some years, and I entertained a very high opinion of him, not only as regards his character, but also as regards his scientific knowledge. He was practically and thoroughly acquainted with physical geology, which, had he continued his connection with this Company, would have been greatly to the advantage of the Company. If the mover and seconder will permit it, a few words, expressing our sympathy with his bereavement, might be added on to the resolution.

The VICE-CHAIRMAN: With your permission I will then move "That John Pender, Esq., M.P., who now retires, be, and he is hereby, re-elected a director of this Company; and that this meeting do take this occasion to record its deep regret at the loss which Mr. Pender has recently sustained in the death of his son." This is proposed by myself, and seconded by Mr. Massey. Those in favour of it will signify the same in the usual manner. Those of a contrary opinion. Carried unanimously.

The CHAIRMAN: My lord, Mr. Massey, and Gentlemen: I am deeply

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grateful for the kind words which you have used in proposing my re-election at the board of this Company, and the words of sympathy which accompany it. If there is one thing which in this world I desire more than another it is to see this great system of telegraphy carry out the great work that I always felt it was calculated to do. I believe that, beyond being a source of investment to its shareholders, submarine telegraphy, in its action, has done more for human progress than anything that has existed during the last fifty years. It has connected every centre of commerce, every part of the civilised world, with this great financial centre of London. We have not been selfish in this, because there is not a city on the continent of Europe that has not derived precisely the same benefit that we have derived. I therefore feel that every man who had the courage to put his money into this submarine telegraph system must feel a very great amount of satisfaction at the part he has taken in the progress of civilisation and good feeling throughout the world. My son, who is lost to us all now, was a young man of great promise. Not of my thinking or of my thoughts, but on the part of Sir James Anderson, who wished him to join the Company and assist him in many of the onerous and important duties he has hourly to perform. He went with me on the trip when I visited all those offices which I have referred to, and while we were staying in Rome, and in the Company's service, the disease which carried him to his long home attacked him. He was a young man of great promise, full of knowledge and information, and it is a deep and serious loss to his family. I feel that had he lived he would have shown by his zeal and interest the same desire to promote your interests as I hope I have done since I have had the honour of belonging to the Company, which has been from its formation.

Gentlemen, the next resolution that I have to move is one which is carrying out to some extent an often-expressed wish of our shareholders, namely, that we should, when a convenient opportunity occurred, reduce the number of our directors. I am quite free to admit that a very large board is not always the most efficient board, but, at the same time, we have tried as far as possible to mark every man at our board for respective duties. The gentleman who has retired now has done so because his employment and occupations are such that they preclude him from giving the attention at our board that he desired to give, but we have still the assurance from him that the same interest will be shown in our affairs by him that he has always shown, and that interest has been very considerable indeed on occasions—I refer to Baron d'Erlanger. He now retires, and instead of filling up the vacancy thus caused, we feel, with all the knowledge we have acquired in these years, that it is not necessary at the present moment to put another director in his place. If it should occur at any time that the working of this Company requires an additional director for some special purpose we will come before you to ask you to give us the power to increase the number in the same way as we ask you to-day to give us the power to reduce the number. The article 74 of the Articles of Association is as follows:—"The number of directors (other than extraordinary directors) shall (subject to alteration by a general meeting) not be less than eight or exceed twelve." Now we have altered that to seven. Therefore the saving of the special director's fees now goes into the accounts of the Company, and is not taken by the remaining directors. But you will observe that there is on the direction Mr. Stronge. Mr. Stronge became a director officially, a Government director, at the time the South African Company was formed. As you are aware that company receive from the Government a considerable subsidy. Mr. Stronge represents the Government as an official director. I hope that Mr. Stronge's long experience of many years in the Treasury will be an additional evidence to you that we have in him perhaps all the assistance and all the experience (because he has always been a telegraph director for the Government) that are necessary for us at the board. Therefore we have now put his name on the list of directors, but I may mention to you that he does not draw the fees. I should like it to have been otherwise, as far as I am concerned, because he is thoroughly entitled to them, and by and bye if we are prosperous and successful, I may ask you to refer again to that question. The resolution is, "That the minimum number of directors (other than extraordinary directors) shall henceforth be seven instead of eight as provided by Article 74 of the Articles of Association."

Mr. G. G. NICOL: I beg to second that.

The CHAIRMAN: Those in favour of that motion will please to signify the same in the usual manner. To the contrary. Carried.

Major LESLIE: I wish to give notice of an amendment in the Articles of Association. Shall I do so now or later on?

The SOLICITOR (Mr. Burt): You cannot do anything like that now.

Major LESLIE: I mean for next meeting. I give notice that I will propose that our Articles of Association be so altered that at all half-yearly meetings, heretofore usually held in January and July, the shareholders shall have the power to alter the rate of dividend as recommended by the directors, either to increase, diminish, or——

The CHAIRMAN: I am quite sure, Major Leslie, you would not arrogate to yourself the entire and supreme direction of this Company. We, your directors, must be trusted to declare the dividend which we consider proper. We are as anxious to increase it as you are; but if we allow you to pass that resolution we may as well remain at home.

Major LESLIE: I presume that this resolution will be discussed at another meeting. I do not dispute the wisdom of the directors; but I think I bring forward an important principle in this motion, and it ought to be more generally recognised; it is that the final tribunal to decide what is a proper dividend is the decision of a public meeting. I have the greatest confidence in the chairman, for he has brought us through all these difficulties.

A SHAREHOLDER: Is it possible to bring this matter forward?

The CHAIRMAN: Major Leslie has a perfect right to put anything forward, and at the next meeting we can discuss it.

The SOLICITOR: The Articles of Association, which means the constitution of the Company, say that "no larger dividend shall be declared than is recommended by the board." It is clear from that that it is competent to the shareholders to reduce the dividend or to have none at all, but it is one of the features of the constitution of the Company that the dividend cannot be increased. The only way to alter this is to have an extraordinary meeting, to pass a resolution at that meeting by three-fourths of the shareholders present, and when passed at the first meeting it will have to be submitted at another meeting. I venture to consider that the shareholders will think that an element of that kind is not to be dealt with lightly at a meeting at which the shareholders have not had notice. I do not think the directors would consider it necessary to convene a meeting for the purpose unless a requisition were sent to them.

Major LESLIE: I must decline to offer any further remarks, as the gentleman has not the courtesy to hear me on the subject. I therefore hand in this resolution.

The CHAIRMAN: I know you wish to do the thing in a perfectly regular way, and that you do not wish to force on your fellow shareholders or the board anything that is unconstitutional, because this is the constitution of the Company; but if you will consult with our solicitor as to the best way of bringing anything that you wish to bring before the body of the shareholders we shall be perfectly ready to receive it and discuss it in a fair spirit.

Mr. RIXON: I have much pleasure in proposing the following resolution:—"That Mr. Henry Dever and the firm of Messrs. Quilter, Ball, Crosbie, Glegg, and Welton be, and they are hereby, elected auditors of the Company for the current year, with a joint remuneration of £100." I believe they are the same auditors who have audited the present accounts, and who have kept them in the most satisfactory way as before.

Mr. WEIR: I beg to second the motion.

The CHAIRMAN: It is proposed by Mr. Rixon, and seconded by Mr. Weir, "That Mr. Henry Dever and the firm of Messrs. Quilter, Ball, Crosbie, Glegg, and Welton be, and they are hereby, elected auditors of the Company for the current year, with a joint remuneration of £100." The motion was carried unanimously.

Dr. WALLER: May I ask you (for it passed so rapidly) what have you done with the notice which Major Leslie has given, for it appears to me, with the greatest respect, that you have no power to receive it.

The CHAIRMAN: I have said if Major Leslie will see our solicitor and arrange with him as to the proper and legal way of bringing any question before the next meeting we shall consider it.

Dr. WALLER: Then I assume that Major Leslie has withdrawn that resolution for the present. Where is the mode by which that matter is to be raised at an extraordinary general meeting?

The SOLICITOR: It is received, but not necessarily acted upon.

Major LESLIE: I have put a notice in, and I do not withdraw it. What the chairman said was quite right, but if this is not a right and legal proceeding my resolution falls to the ground.

Mr. NICHOLSON (a shareholder): I rise to propose a cordial vote of thanks to the chairman and directors of the Company. I am quite sure we shall be unanimous in this. I should like to add to the resolution our appreciation of your good services in time of trouble. I suppose that we shall have full particulars of this meeting circulated, so that the shareholders may know that we appreciate what you have done. We all hope for a long time to see you and our managing director in your present positions.

Dr. WALLER: May I have the pleasure of seconding the motion? I beg most cordially to respond to every word that has fallen from the gentleman who has proposed it, and I think we are all convinced of the great ability, industry, and talent you have brought to bear, as president of the society, on the Company and its prospects. I hope that we shall long see you in that position.

The SOLICITOR put the motion, and declared it carried unanimously.

The CHAIRMAN: Gentlemen, on behalf of myself and co-directors I beg to return you our very best thanks. I can only assure you that it is the desire, the anxious and deep desire, of your board to carry on this business in a way that will give you satisfaction, as well as the general public, who after all are our customers.

The proceedings then terminated.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Feb. 2.		Business Done Week Ending Feb. 2. Highest.	Lowest.
Anglo-American Ordinary	60,	⅛	60⅛	59⅛
Do. "B"	88,	¼	88¼	88¼
Do. "A"	32½,	¾	32¾	32½
Brazilian	9 15-16,	10 1-16	10	9 15-16
Cuba	8½,	9	9	8 11-16
Do. Ten per Cent. Pref.	16½,	17½	—	—
Direct Spanish	3,	¼	—	—
Do. Ten per Cent. Preference	12½,	13	—	—
Direct United States	11¼,	½	11¼	11¼
Eastern	9 9-16,	11-16	9 13-16	9 9-16
Do. Six per Cent. Debenture	104,	106	103	102
Do. Five per Ct. do. 1899	103,	105	—	—
Do. Six p Ct. Pref	12½,	¾	12½	12½
Eastern Extension	10⅛,	¼	10⅛	10⅛
Do. Six per Ct. Deb	110,	112	—	—
German Union	9½,	10½	10½	10
Globe Telegraph & Trust	6 7-16,	9-16	6 9-16	6 7-16
Do. Six p Ct. Preference	11 15-16,	12 1-16	12½	12
Great Northern	10½,	11½	11	11
Indo-European	26,	27	—	—
Mediterranean Extension	2½,	3½	3	2½
Do. Eight p Cent. Pref	10½,	11½	—	—
Reuter's	10½,	11½	—	—
Submarine	265,	270	—	—
West India and Panama	1⅛,	¼	1 13-16	1⅛
Do. Six per Cent. 1st Preference	6½	¾	7	7
Western and Brazilian	7⅛,	¾	8	7⅛
West. Union 7 p. Ct. 1st Mt.	122,	127	—	—
Do. Six per Ct. Sterg.	104,	107	—	—

TRAFFIC RECEIPTS FOR JANUARY, 1881.

Companies.	Jan., 1881.	Jan., 1880.	Increase.	Decrease
Cuba Submarine Company	2,800 estd.	3,406	—	606
Eastern Telegraph Company	49,445	48,887	558	—
Eastern Extension Telegraph Company	29,434	28,009	1,425	—
Great Northern Telegraph Company	17,360	—	—	—

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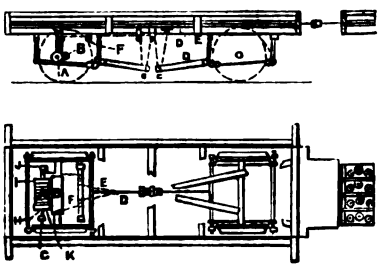
ABSTRACTS OF SPECIFICATIONS.

—o—

2453.—ELECTRIC APPARATUS FOR WORKING RAILWAY BRAKES. *J. C. Mewburn.—Dated 17th June*, 1880.—(*A communication from F. A. Achard.*) 6*d*.

This is an improvement on a former apparatus invented by M. Achard, of Paris. Its leading features are as follows:—If the commutator be worked in order to put on the brakes, the two extreme piles placed, the one in the front, the other in the rear van, both send their current into the electro-magnets of all the carriages; thus if the tension of one of the currents diminishes gradually in intensity by going further from the pile which engenders it, each vehicle will none the less receive an equal quantity of electricity by the addition or combination of the two currents arising from the simultaneous action of the two piles, because the intensities of the two piles progress or vary in an inverse sense. The brake apparatus also works automatically and in case of a breakage instantaneously. In Figs. 1 and 2 the ordinary brake levers *a*, which act on the blocks *b*, are fitted at their ends with grooved pulleys, *c*, over which passes a chain, *d*, the end of which is fixed at d^1. To this chain are attached two others, *e*, carried obliquely, which are wound several times over a drum, *f*, suspended under the carriage frame. These chains, *e*, afterwards pass over guide pulleys, *g*, and their ends are attached to the axis *h* of the electro magnet A. Or the chains *e* may be led directly from the drum *f* to the axis *h* of the electro magnet A. This electro magnet has at each end a disc, *i*, intended to

2453



touch the axle and be rotated by it by friction. A is suspended to the carriage frame by rods, *j*, and spring plates, *k*, of steel, copper covered; and it is by these that the current is transmitted to A. At the upper end of each plate, *k*, abuts a wire, attached to the general conductor, which extends the whole length of the train, so that each electro magnet is supplied by derivation from the main circuit. When a current is sent into the main circuit the electro magnet A is attracted towards the axle B, and is made to turn, being driven by friction; the chains *e* wind upon the axle *h* of the magnet and raise the brake levers *a*. As soon as the current ceases the levers fall by their own weight and the brakes are released. The electric piles employed are by preference those of the Planté system. Instead of employing piles as the source of electricity for operating the brakes, magneto electric and dynamo-electric induction machines can be employed, worked by the wheels of the vans in which they are placed; or, again, an induction machine may be placed on the locomotive and put into motion by a rotary steam engine or by an ordinary cylinder engine. The employment of induction machines equally allows of the brakes being automatic. For charging or priming these machines it will be well to add a small magneto-electric machine, with permanent magnet, which will be actuated by the axles of the van, and if required can be arranged on the same shaft as the large machine. This small additional machine will furnish a current all ready for changing the direction of the action. It will work as a relay pile for producing the automatic action of the brakes, any breakage of the coupling having the effect of closing the circuit which acts on the electro-magnets of the brakes.

2610. IMPROVEMENTS IN TELEPHONES. *J. H. Johnson.—Dated 26th June*, 1880.—(*A communication from F. A. Gower.*) 6*d*.

Mr. Gower combines a microphone with a magnetic telephone. A microphone preferably having at least six contact points is attached to the upper part, K, of box A, a Gower chronometer telephone, C, being in the lower part of the box. The telephone is provided with a double speaking tube as shown. Commutators are used to interrupt battery current and open call bell circuit. The hanging of the tubes, as in figure, causes break of contact between commutators E and binding post E^1. The microphone is not necessarily fixed as in figures, but may be attached at any convenient point. This arrangement affords all the advantages obtained by the employment of a battery for the purposes of telephonic communication without its accompanying objections, and without destroying the effect of the said telephone when it is employed as a transmitter in the case of a battery failing to act or becoming exhausted. Fig. 1 is a front elevation of the improved apparatus, a part of the front of the box being removed in order to show the position of the commutator. In this figure it will be observed that

2610 FIG. 1

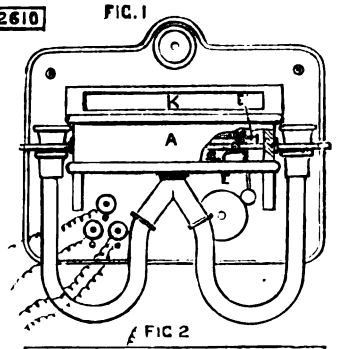
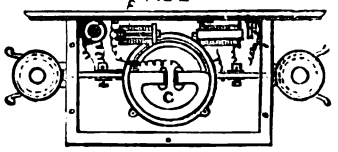


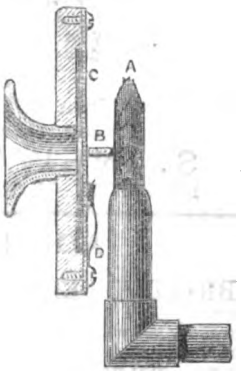
FIG 2



the commutator is not in contact with the binding post. After working the apparatus the extremities *d* of the accoustic tubes D, D^1, are placed in holders connected with the commutators E, and the circuit is thereby interrupted, as shown in Fig. 1, in which figure the commutator E is shown out of contact with the binding post. An electric call bell is provided underneath the box, and a knob for working the call bells is placed at the upper part of the apparatus, but this arrangement is not essential to the working of the invention. An induction coil is placed inside the box, and the microphone B and the battery are connected to the primary circuit, whilst the Gower telephone and the line are connected with the secondary circuit. In speaking against the upper part, K, of the box, which part may be of wood, iron, brass, or other suitable material, and near or upon the under surface of which the microphone is placed, either with or without attaching the microphone to the box top directly, the sound waves from the voice form electrical undulations in the primary circuit through the action of the microphone; and these undulations are reproduced in the secondary circuit by induction, and thus repeated in the Gower telephone at the receiving station. The witness claims the combination with a magnetic telephone of a microphone, the two instruments forming constituent parts of one and the same apparatus, and the employment in the combination of a flexible double tube for speaking and listening.

235120. PHOTOPHONIC TRANSMITTER. *By Emile Berliner, of Boston, Massachusetts.—Dated Sept.* 3, 1880.

This improvement relates to that kind of instruments called "photophones," in which a beam of light is set into vibration by being reflected from a vibratory reflector, or in which the amount of light transmitted at each sound-vibration is regulated by the movement of a diaphragm or other vibratory medium. In this improvement he makes use of a heat-flame of low luminous quality—as, for instance, the flame of a Bunsen burner, or of an oxyhydrogen light, which is hardly visible, but which may heat other substances brought into its reach to incandescence, so that they become luminous, and to an extent as they are brought into contact with the flame, and he arranges a pencil of platinum, calcium, asbestos, or similar refractory substance so that its point is just in contact with the said flame, and vibrates this pencil by means of a diaphragm, to which it is secured, or by which it may be acted upon. By this means he brings more or less of the pencil in contact with the flame, and the light emitted by the pencil will therefore in strength be proportionate to the amplitude of



each vibration, and light-waves, varying in intensity and number in proportion to the transmitted sound-waves and their intensity, will result from this manipulation. In the drawing, A is a heat-flame of low luminous quality—as, for instance, a Bunsen flame or an oxyhydrogen light. B is a pencil of platinum, calcium, asbestos, or similar refractory substance, with its point just in contact with the flame. The pencil is attached to the centre of a diaphragm, C, suitably mounted and provided with a mouthpiece like the mouthpiece of an ordinary Bell telephone, and this diaphragm may or may not be provided with a damper, D. By uttering now or producing sound in the neighbourhood of the diaphragm the same will vibrate, and the pencil B will be brought in more or less contact with the flame, and will give out a light of varying brilliancy, each vibration in accordance with the amplitude of the transmitted sound-wave. The inventor claims a photophonic transmitter consisting of a heat-flame of low luminous quality, A, a pencil, B, of refractory substance in contact with the flame, and diaphragm C.

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SLIP

THE LEGION OF HONOUR.—M. Marcel Deprez has just received the order of Chevalier de la Légion d'Honneur.

WEST INDIES.—The cables between Porto Rico and St. Thomas and between Porto Rico and St. Croix are interrupted.

TELEGRAM FORMS.—The annual consumption of telegram forms throughout the United Kingdom amounts to 137 millions.

SOUTH AFRICA.—Although the land wires continue to be cut in isolated places, telegraphic communication is, on the whole, now working well.

ELECTRIC RAILWAY FOR ADEN.—We hear that Mr. Silbiger has contracted for the construction of an electric railway between Shipping Point and the camp.

CHINESE TELEGRAPHY.—It is said that the Chinese Government has granted a concession to a native company for the construction of a telegraph line from Pekin to Shanghai.

ANOTHER STORM.—Owing to the severe snow storm and gale on Monday the Post Office gave notice of delay in the transmission of messages from and to Ireland, Newcastle, and Aberdeen.

THE PARIS ELECTRICAL EXHIBITION.—Several electrical railways will, it is stated, be at work at this Exhibition, the largest being in the British Section, and constructed by Messrs. Siemens Brothers.

NON-ACTION OF A TIME SIGNAL.—From Greenock we hear that the time signal at the Caledonian Railway Station missed on Sunday morning at ten o'clock, but was repeated from Greenwich at eleven o'clock.

TELEPHONIC.—A correspondent informs us that there is a firm of stockbrokers of the same name as the editor of a certain—or, rather, uncertain—comic weekly; and he asks whether this is where the laugh comes in?

THE TELEPHONE ABROAD.—From Egypt it is reported that the Ministerial consent has just been given to a telephonic exchange for Cairo; whilst Paris is to have an addition to its telephone lines which will complete the circle of communication.

EXPORTS.—The value of telegraph wires, &c., exported during the month of January last was £57,227, which is much in excess of the figures for the same period of 1879 and 1880, the total exports for January of those years being £40,719 and £31,813 respectively.

TELEPHONE IN NEW ZEALAND.—We hear that the Telegraph Department, having procured a supply of Edison-Bell telephones, state that they are prepared, if sufficient applications are received, to establish the telephone exchange system in Wellington, the annual charge for which will be £17 10s.

THE ELECTRIC LIGHT ON RIVERS.—It is proposed to employ the electric light on board the steamers navigating the Guadalquivir. Owing to the dangers of navigation on this river, all movement of vessels by night has been prohibited, thus causing great loss and delay, which it is expected will be obviated by this means.

EUROPEAN TELEGRAPHS.—The statistical abstract for the principal and other foreign countries for 1878-9, just issued by the Board of Trade, gives particulars with regard to European telegraphs up to 1878, with the exception of Russia, the particulars for which are only given for 1876. It is now A.D. 1881!

PRICES.—The prices of gutta percha as quoted are:—For genuine 4d. to 3s. 3d. per lb.; for reboiled 3d. to 1s. 3d. per lb.; india rubber, per lb., Para, fine, 3s. 4d.; negrohead, 2s. 3d.; Central American, 1s. 9d. to 2s. 4d.; Assam and Pegu, 1s. 2d. to 1s. 11d.; other East Indian 1s. 9d. to 2s. 3d.; Madagascar and Mozambique, 1s. 8d. to 2s. 3d.

TELEPHONE AT DARLINGTON.—A lecture on the Telephone was given here lately by the Rev. Mr. Hunnings. Having explained the nature of the instrument to the audience, the lecturer left the hall and proceeded to an office some distance away, from which he addressed them, his voice being distinctly heard. Mr. Hunnings concluded by a description of the photophone.

ELECTRICAL EXHIBITION AND AMERICANS.—*L'Electricité* says that the proposed International Exhibition has created quite a furore among American electricians, and the New Yorkers have started the idea of an exhibition in New York in 1882. What a chance for us to triumph in the city where have dwelt Morse, Henry, Franklin, Field, Graham Bell, and Edison! says our contemporary.

PLACE AUX DAMES.—Following in the footsteps of the sterner sex, we find the female clerks of the Central London Telegraph Office are imitating their brothers, and petitioning to be put on the same footing as the female clerks in the Savings Bank and Telegraph Message Departments. We have no doubt that if they are like the rest of their sex they will gain their end, let the Postmaster-General harden his heart never so much.

TELEPHONE EXCHANGE FOR NEWPORT.—It is proposed to establish a telephone exchange for Newport and Cardiff; the Post Office have been communicated with, but at present they have not been able to state definitely the cost of the scheme, though it is thought that the local exchange at Newport will not cost more than £14 per annum. The scheme is being heartily taken up by the merchants of both places. Similar information reaches us from Hull.

NARROW ESCAPE OF A TELEGRAPH OFFICE.—The telegraph office of Neustadt, near Vienna, has had a narrow escape. It appears that a meteoric stone fell in the road before the door with a terrific noise, and accompanied by a brilliant flash of lightning. The stone, which was afterwards exhumed from the hole it had made in the road, was weighed in the presence of scientific men, and found to be 375 grammes in weight. It was covered with metallic incrustations.

ELECTRIC LIGHT FOR FRENCH LIGHTHOUSES.—The director of French Lighthouses has sent to the Minister of Public Works a communication recommending the lighting, by electricity, of all the great lighthouses on the French coasts. It will involve an expenditure of several millions of francs, which will end in a large economy and an extension of the range of illumination. A system of steam-trumpets is also to be established in connection with these improved lighthouses.

AN ELECTRIC HEAD-LIGHT FOR LOCOMOTIVES.—An electric head-light for locomotives will soon be tried on the Cleveland and Pittsburg Railroad. The power will be furnished by a small engine placed behind the smoke-stack, and furnished with steam from the main boiler. It seems to us that electric head-lights are always going to be tried. It is about time that American locomotive superintendents—we beg pardon, master mechanics—began. The electric head-light is just the thing for unfenced railways.—*Engineer.*

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JOHNSON'S TELEPHONE AT SHEFFIEED.—We learn that Mr. Johnson's microphonic transmitter has this week been established between the works of Messrs. John Brown and Co., in Sheffield, and their collieries at Car House and Aldwarke, a distance of eight miles. One of these instruments has also been fixed for Messrs. Steel, Tozer, and Hampton at the Ickles, and connected with their offices in George-street, Sheffield, and the Central Telephone Exchange. The effect in conversation is said to surpass that of other instruments attached to much shorter circuits.

TELEPHONE IN MADRAS.—The *Homeward Mail* says that, at a meeting of the Chamber of Commerce, on Jan. 10, Mr. C. D. Leggatt, Director General of the Oriental Telephone Company, said his company was prepared to introduce the telephone into India, provided that the company should not be hampered by any undue interference of Government, and on condition of a guaranteed minimum subscription of £2,000, the sum for which he had offered to introduce the telephone into Bombay and Calcutta. This would (he stated) give the benefits of the telephone within a radius of a mile, and for this the company would erect the wires and keep them in repair.

THUNDERSTORM AT PLYMOUTH.—During Monday night a terrific thunderstorm passed over Plymouth and its neighbourhood. The lightning was exceedingly vivid, and the storm culminated in a hurricane, accompanied by a fall of hail which, in the neighbourhood of Tavistock, was quite an inch in depth. The peals of thunder shook the houses to the foundation, and a house on the road to Princetown was struck by the lightning and completely wrecked. A bed in which a man was sleeping was charred and the occupant had a narrow escape, whilst his wife, who was ascending the stairs at the time, was struck. A watch she was carrying in her hand was smashed to atoms, the furniture was also broken, and the walls of the house were rent.

THE BÜRGIN DYNAMO MACHINE.—Mr. Crompton, in his lecture before the United Service Institution, mentioned the Bürgin machine as one coming into competition with others already in the market. We have before us a letter from M. Bürgin, giving the results of some competitive trials made with this machine in Switzerland. It should be premised that, according to our present knowledge, the machine used was the first made by Mr. Crompton, and it is well known that the first machine, as a rule, does not compare favourably with others made after some experience has been gained. The Bürgin machine, with three lights, gave 800 candles per actual h.-p.; with four lights it gave 560 candles; while the Siemens alternate current machine, with six lights, gave only 262 candles per actual h.-p. We shall refer to this machine again in our next issue.

EDISON'S NEW DYNAMO-ELECTRIC MACHINE. — Mr. Edison having practically demonstrated, says the *Scientific American*, that the highest economy in the conversion of power into electricity is reached only by the use of large machines, he has now designed one that is to replace sixteen of the largest machines of this kind previously made. Power is applied directly to the armature without the intervention of belts. The dynamo and driving engine are mounted together on a cast iron bed 8½ft. by 7ft., and 2ft. deep, the entire machine weighing eight tons, of which the armature alone represents one and a half tons. The engine is of 100 horse-power, with steam pressure 120lb. per square inch. Our contemporary further states that the current from this machine (when it is completed) will suffice for 800 incandescent lamps; and it is estimated that the consumption of every 3½lb. of coal per hour will generate a nett current sufficient for 8¾ incandescent lamps of 16 candles each, or 16 lights of 8 candles each.

LANE FOX'S LAMP.—A public exhibition of this system of electric lighting was held on the 4th February in the Westminster Palace Chambers, under the auspices of the British Electric Light Company. This lamp is similar in appearance to that of Mr. Swan. It consists of an incandescent carbon loop in an exhausted globe. Of course the only secret is the material of which the carbon strip is made. Further, the material is restricted to vegetable fibre, and improvements upon Mr. Swan's lamp, if possible, will depend mainly on the improvements in the substance forming the carbon strip. During a short explanatory lecture Mr. Fox maintained that the electric light was not only better, but could be produced more economically than light obtained by the destructive distillation of coal. The whole matter can be practically demonstrated without much difficulty. We would suggest that some of the citizens of the West End, to whom money is no object, combine and ask the British Electric Light Company to supply their houses with the electric light for the same amount as is now paid for gas. We believe the company would enter heartily into the trial, and would without fail demonstrate that electricity can be used for lighting interiors, and we do not hesitate to say the citizens who agree to the experiment would not return to gas again.

TELEGRAPH CLERKS' GRIEVANCES.—A meeting of the postal telegraph clerks of Birmingham was held at the Bull-street Coffee House on Saturday last, to receive the reports of the delegates sent to represent Birmingham, Nottingham, Worcester, Oxford, Derby, Leamington, Reading, and Northampton at the conference of the staff of the United Kingdom held in Liverpool. The delegates stated that it was resolved at the conference to ask the Postmaster-General to receive a representative deputation from the various staffs of the United Kingdom, it being the impression that by this means Mr. Fawcett could have all the facts of the grievances laid before him, and thus be enabled to arrive at what he desires—that is, a just conclusion. Since then the Liverpool Committee had received an intimation from Mr. Fawcett that he did not see the necessity for such a deputation, but if the statements contained in the petitions did not fully explain their case he would summon members of the provincial staff to supply him with further information. It was stated that there is scarcely a Cable company who do not start their staff at a commencing salary of £80 per annum—a sum far greater than the majority of them could ever hope to attain under the present system of promotion. One of their own staff on joining a Cable company was considered worth £200 per annum, whilst the Post Office valued his services at £70, at which salary he would have remained for the next eight years.—A vote of thanks was passed to the delegates for the manner in which they represented the staff, the meeting fully endorsing their action at the conference.

THE NEW AMERICAN TELEGRAPH AND CABLE COMPANY. —"The consolidation under one organisation of the Western Union, the Atlantic and Pacific, and the American Union Telegraph Companies is but preliminary," says the New York *World*, "to the development under one management of a grand telegraphic network extending round the world, and having its centre not in London but at New York." The new cable company, co-operating with the amalgamated companies, will," continues the *World*, "at once proceed not only to increase the existing cable facilities between this country and Europe, and to extend southwards the cables which now connect this country with Cuba and the West Indies, but also to lay

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cables under the Pacific from San Francisco to Honolulu. From Honolulu the cable will be laid under the North Pacific to Japan, connecting there with the cable from Itoki to Shanghai, and another under the South Pacific by way of Ellice's Islands and the Friendly Isles to New Caledonia, and thence to Brisbane in Australia, where it will connect with the Australian and New Zealand cable system in one direction, and with the Australian and Straits system in the other direction." Mention is also made of carrying a cable from Vancouvers Island to North Japan "by way of Alaska and Petropaulowski." The company has a capital of 20,000,000 dollars, with power to increase. The same paper of Feb. 7 publishes an account of an interview of a member of its editorial staff with Mr. Jay Gould and one of the new directors of the Western Union Telegraph Company, who are represented to have stated that the object of the consolidation of their line with the American Union and Atlantic and Pacific Telegraph Companies was to develop telegraphy by land and sea. They added that two cables were now under contract in the United States to be laid to England early next summer. Does not this savour of tall talk?

Earth Currents.—Our contemporary *Nature* has given publicity to a statement that is hardly in accordance with fact. It says:—"A remarkable discovery has been made by Mr. Alexander Adams, one of the technical officers of the Post Office Telegraph Department. It is the existence of electric tides in telegraph circuits. By long-continued and careful observations he has determined distinct variations of strength in those earth currents, which are invariably present on all telegraphic wires, following the different diurnal positions of the moon with respect to the earth. He will read a paper on the subject at the next meeting of the Society of Telegraph Engineers to-morrow." We do not dispute that Mr. Adams has made this discovery, but a paragraph of this kind leads the public to think that the discovery is new. No doubt Mr. Adams has made the observation independent of other observers. Yet we think the members of the Society of Telegraph Engineers will remember a series of diagrams shown by Mr. H. Saunders at the conversazione held some years since, if we mistake not, at Willis's Rooms. These diagrams, which were verbally explained at the time, show most conclusively the remarkable discovery now credited to Mr. Adams. Mr. Saunders has some thousands of recorded observations, made, so far as we recollect, at intervals of fifteen minutes day after day, and what renders these observations still more valuable is that the records are kept for stations a long distance apart. Besides the observations by Mr. Saunders there are those obtained for years past at the Observatory at Greenwich, which we have reason to believe show the same fact. Owing to the change in the day of the meeting of the society we are compelled to write before hearing the paper, and will, therefore, content ourselves with the further remark that we are somewhat surprised at the manner in which the "pith" of a paper is allowed to be made public beforehand whilst great difficulties are put in the way of obtaining any account of the paper itself when read.

Telegraphy in Italy.—The Italian Minister of Public Works has prepared and laid before Parliament a Bill for the regulation of the telegraph service. The most important provisions are as follows. The Government asserts its exclusive right to the exercise of all systems of signalling, whether telegraphic, telephonic, or of any other kind, with the exception of those for private use and naval signalling. It is, however, at liberty to make arrangements with private persons, giving them permission to work such systems on paying for the privilege an annual fixed sum, or assigning to the Government a certain share of the profits. Municipalities, railway and tramway companies, are allowed to work telegraph lines free of such payment; but they are obliged in return to do telegraphic business for the Government and the public, receiving a share of the profits. The erection of telegraph posts wherever the Government thinks fit cannot be opposed by the owners of the land upon which they are to be placed. Fishing, sounding, and anchoring near submarine cables, are forbidden. The Press may be allowed reductions on the usual charges (not exceeding 75 per cent.) on condition of furnishing gratuitously copies of the messages so sent to certain officials to be hereafter named. No telegram may be refused or delayed, except such as contain seditious or offensive language, or are sent with criminal design, or intent to hinder the course of justice. The telegraph officials have the responsibility of carrying out this regulation. The Government may, if necessary, assume complete political control of this service by a Royal decree, issued with the concurrence of the Ministers, to be subsequently laid before Parliament. Secresy is secured, except for judicial purposes. Suppression and opening of telegrams, and tapping the wires, are declared legal offences. If such offences (with the addition of fraudulently altering telegrams) are committed by an *employé*, he is liable to suspension from public offices and imprisonment for two years; and if he has been bribed, or if his act has been injurious to any one, he is liable, in addition, to a fine of 2,000 lire (nearly £80).

Electrical Shadows.—From Göttingen we hear of some curious phenomena—electrical shadows—which have been lately described by Herr Holtz to the Academy. The best way of obtaining them is by fixing to one discharge rod of a Holtz machine a large concave disc with a piece of silk without wrinkles adhering to it by electric action; at the point of the other rod, placed opposite, appears, when the machine is worked, a small, feeble, luminous star, and on the disc a luminous circle, and the shadows appear on the latter when objects are interposed. That they are not optical shadows is proved, *inter alia*, by the fact that not all objects give them. They are produced in general only by conductors or semi-conductors; insulating bodies, when small, give no shadow; when large they may give some shadow at first, but this gradually goes out as the action of the machine is continued. It makes no difference whether the conducting bodies are connected with the earth or insulated. The shadow-forming power is to be measured not only by the darkness of the image but by the magnification. Herr Holtz tried pasteboard, ebonite, silk, linen, knitting needles, and glass rods or tubes; the former he used in the form of strips, crosses, and rings. The size and form of the shadows are affected by various things. The shadow is larger or smaller according as the body approaches the point or the larger surface; it enlarges, too, outwards from the centre of the disc, so that the shadow of a strip of uniform width is narrowed in the middle. It is further notable that, to a certain limit, a strip gives the same shadow, whether it is placed with its broad side or its narrow edge towards the disc. A system of strips placed edgewise gives the same shadow as a homogeneous piece. Various instructive experiments may be contrived—thus, a cross of pasteboard and ebonite gives only the shadow of the pasteboard, but by breathing on the cross a full cross-shadow momentarily appears. A glass rod with one end made conducting by heat gives a partial shadow, which gradually disappears on cooling, and so on. Herr Holtz does not at this stage say much as to what the phenomena mean.

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MEANS OF MEASURING RESISTANCE.

BY M. KOHLRAUSCH.

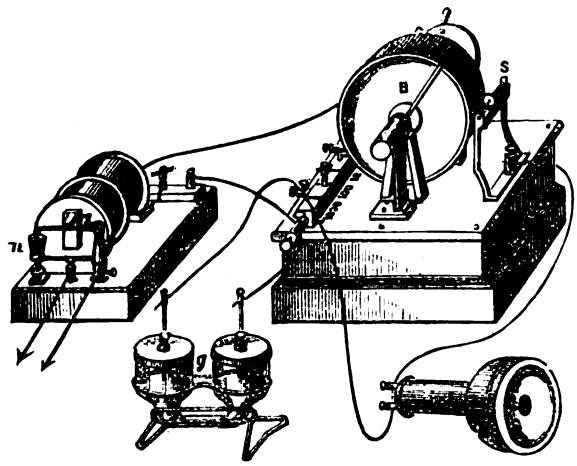
In order to arrive at an easy method with simple apparatus, M. Kohlrausch uses the arrangement represented in the figure below. The principle of the system is that of the Wheatstone bridge, but the various apparatus used are arranged in a particular way.

The electric generator designed to react on the indicating apparatus is an induction coil which will be noticed at the left of the figure, and which is divided into two compartments, so as to enable the currents produced to be used with more or less tension or quantity; and as there is no need of instantaneous currents, the core of iron, instead of being composed of a bundle of iron wires, is formed of one soft iron bar of 16 mm. diameter. The trembler has as a means of contact some mercury placed in a receptable, N, and to avoid a spark a stratum of distilled water is placed above the mercury. The coil, which is 10 centimetres long, has 6 layers of induction wire of 0 mm., 8, which give 522 turns, and the induction helix of fine wire gives about 2,800 turns. The vibrations of the apparatus allow of about 200 currents passing in a second when connected with a Bunsen battery of 2 elements, or a Daniell of 3, or a Smee of 6 or 8.

The resistance measurer, strictly speaking, is made up of 3 series of resistance coils, two of which compose the two equal sides of the bridge, and the third the balance side. This includes 5 coils, the resistances of which are 1, 10, 100, and 1000g.e., and the metal contacts of all these coils, placed as ordinarily with reunion stops, are completed by a kind of Jacobi rheostat, B, made up as follows:—

On a wood cylinder, B, 45mm. in length and 100mm. in diameter, an helicoïdal groove of 10 turns is run, on which is wound a brass wire of 25 resistance, and quite bare. The contact sliding on this wire is made by a hollow cylinder, which covers the wire over a portion of its circumference, and which is fixed on an axle, S, kept in place by two springs. By the system of jointing the sliding contact shown, it can fall back on its axle when the cylinder is turned. According to the author, by this means we avoid thermic currents. The cylinder and the axle are made of pure silver, and it is the springs which induce the currents in them. The wire of the rheostat has on the other side one of its ends in connection with the axle of the cylinder, and the rubber which does duty as a current collector is formed by a kind of brush of twenty or thirty brass wires similar to those used in the dynamo-electric machines.

The indicator, which by its immobility signifies when the resistance under examination and the resistance of the rheostat are precisely equal, has been varied by M. Kohlrausch. Sometimes he employs his modification of Weber's dynamometer, some-



times, and more often, the telephone, which is by far the most satisfactory when intermittent induction currents are used. With this apparatus measures can be obtained to extreme correctness, and the resistance of short metal wires not wound on bobbins can be measured.

To sum up, one of the sides of the bridge is represented in the preceding figure (1) by the resistance about to be measured, which we take to be the liquid in the receptacles g; (2) by the coils for measuring the resistance and the rheostat; (3 and 4) by the resistances of the end of the rheostatic scale.

When liquids are used, M. Kohlrausch places them in a receptacle composed of two jars in communication, g, closed by two ebony covers, which support electrodes with a surface of 45 mm. The tube which joins these two jars is about 10 centimetres long, with a diameter varying according to the character of the liquids. If they are bad conductors, the diameter should be 14 to 25 mm; if good, it should be reduced to 8 mm. The electrodes are silver plated, and by means of graduated guiding scales on the jars, or on the stems of the electrodes, allow of their immersion in more or less of the liquid, and to a known degree. Further, as it is necessary to work in a known and constant temperature, the apparatus should be placed in a bath of appropriate liquid, and to this end it is supported on a frame of copper wire. The bath is then warmed by the flame of some burner. The jar which contains the bath should be provided with a double bottom to avoid cold currents, and the better way is to place a perforated plate at the bottom of the jar, with four feet or simply a gridiron of iron wire, raised to the height of one centimetre only.

The resistance corresponding to the capacity of the jar is found by filling it with a liquid the conducting power of which is known, and by measuring its resistance.

If the liquid in the jar indicates a resistance of W Q E the capacity of resistance of the jar for the mercury at 0 degrees is $y = WK$. With another liquid giving a resistance W, it is found that its conducting power with the mercury at 0 degrees is:

$$K = y : W.$$

We are ignorant of the date of M. Kohlrausch's labours, but we may say that the idea of utilising the telephone for measuring resistances is not new, MM. Hospitalier and Ader having described it in two articles published in the numbers for the 15th September, 1879, and 1st April, 1880, of *La Lumière Electrique*.

ARTICULATION FROM A CONDENSER.

The first use of a condenser for telephonic purposes was made, we believe, by Mr. C. F. Varley. In his famous 1870 patent he employed a condenser to emit a musical sound when the vibratory currents of his di-plex system of telegraphy were received upon it. After the introduction of Professor Bell's telephone into this country, the condenser telephone was resuscitated and exhibited to audiences in a well-known place of entertainment. By and bye it found its way to France, where it amused and interested a number of French electricians, who christened it by the happy name of the "Condenser Chantant," or singing condenser. Hitherto it has only been employed to translate the intermittent currents of the musical telephone into sound; but quite recently M. Dunand has obtained very good articulation from it.

The best way of getting a musical note from the singing condenser is to connect its poles to the secondary circuit of an induction coil, while a Reis transmitter or a Gray tuning-fork sender is placed in circuit with the primary coil. Then the periodic interruptions of the primary circuit caused by the vibration of the note sounded near the transmitter produce intermittent secondary currents, which charge the condenser successively, and cause it to give out an audible sound in imitation of the original note, by a process of expansion and contraction not very well understood. If a carbon microphone be substituted for the Reis or Gray transmitter, the ticking of a clock or the stroke of a bell can be reproduced in the same way by the condenser; but articulation is quite destroyed, and speech is only heard as a murmuring sound.

M. Dunand, however, conceived the idea of interposing a battery in the secondary circuit of the induction coil together with the condenser—that is to say, of connecting the battery between one end of the secondary circuit and one pole of the condenser, while the other pole was joined to the other end of the secondary circuit. The effect was suddenly changed, and instead of a harsh murmur distinct speech was obtained. The sheets of tinfoil composing the condenser, which when solely under the influence of the induced currents only render simple tones, were found to give forth the most delicate articulations when they were already charged with the electricity of the battery. This is a curious effect, which will, perhaps, help to explain the real nature of the condenser. The intensity of the sound varied with the size and quality of the apparatus employed. The condenser which gave the best results was 6 centimetres in the side, and included thirty-six leaves of tinfoil.

Two different induction coils were tried, one of 7 centimetres and one of 12 centimetres. With the first, which is excellent for making the condenser sing, one Leclanché element served for the primary circuit. With the second two or three Leclanché cells can be employed, and the sounds become more intense.

As to the auxiliary battery, whose presence produces the articulate sounds, it may only consist of two or three elements, but then the sounds are feeble. In augmenting the number of cells the intensity of the sounds is also increased, but not proportionally. With ten Leclanché elements, and the coil of 12

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centimetres with two Leclanché elements in the primary helix, the voice is as loud at least as that of a good telephone; and with fifteen Bunsen elements in the secondary helix the intensity is so amplified that speech can be heard when the ear is the tenth of a metre from the condenser. By intercalating three or four bichromate of potash elements in circuit M. Dunand has obtained still louder effects, but in this case the points of the microphone heat up to such a degree that articulation becomes very imperfect.

Whatever be the true explanation of this improvement in the telephonic powers of the condenser, it is certain that the current from the auxilliary battery does not traverse the condenser, for a galvanometer connected between the condenser and the secondary circuit shows no signs of a current. It is worthy of mention, too, that Mr. Dunand has placed considerably high resistances between the helix and the condenser without sensibly enfeebling the sounds. However the audible vibrations of the condenser plates are produced, it seems clear that when the plates are charged with electricity they are in a more sensitive condition, and capable of vibrating with greater energy for the same disturbing current.

M. Dunand has done good service in endeavouring to push the powers of the singing condenser to their utmost. He has demonstrated that any ordinary condenser can be made to act as a telephone receiver; and in prosecuting his experiments he may perhaps succeed in devising a loud speaking receiver superior to those at present in use. If we remember rightly he is not the first to get articulation from a condenser, the Count du Moncel and M. Herz having both attained a certain amount of success, but M. Dunand has shown how every electrician may easily contrive a speaking condenser.

SWAN'S ELECTRIC LAMPS.

[The following letter, which has been contributed to the *Engineer* by Sir W. G. Armstrong seems to us to contain so much that is valuable that we reprint it.—Ed. *E.*]:—

"Sir: The following particulars of a successful application of Swan's electric lamps to the lighting of a country residence will probably be interesting to many of your readers. The case possesses novelty not only in the application of this mode of lighting to domestic use, but also in the derivation of the producing power from a natural source—a neighbouring brook being turned to account for that purpose. The brook in fact lights the house, and there is no consumption of any material in the process.

"The generator used is one of Siemens's dynamo-electric machines, and the motor is a turbine which gives off 6 horse-power. The distance of the turbine and generator from the house is 1,500 yards. The conducting wire is of copper, and its section is that of No. 1 Birmingham wire gauge. A return wire of the same material and section is used, so that the current has to pass through 3,000 yards of this wire to complete the circuit. The number of lamps in the house is forty-five, but as I can switch off the current from room to room, I never require to have more than thirty-seven in light at once. For this number of lamps 6 horse-power proves to be amply sufficient, notwithstanding the great length of the conducting wire.

"The library, which is a room of 33ft. by 20ft., with a large recess on one side, is well lighted by eight lamps. Four of these are clustered in one globe of ground glass suspended from the ceiling in the recess, and the remainder are placed singly and in globes in various parts of the room, upon vases which were previously used as stands for duplex kerosine lamps. These vases being enamels on copper are themselves conductors, and serve for carrying the return current from the incandescent carbon to a metallic base in connection with the main return wire. The entering current is brought by a branch wire to a small insulated mercury cup in the centre of the base, and is carried forward to the lamp by a piece of insulated wire which passes through a hole in the bottom of the vase, and thence, through the interior, to the lamp on the top. The protruding end of this wire is naked, and dips into the mercury cup when the vase is set down. Thus the lamp may be extinguished and re-lighted at pleasure merely by removing the vase from its seat or setting it down again.

"The dining room is also lighted by eight lamps, six of which are grouped together in one glass shade suspended over the centre of the table, and the other two are used singly as bracket lamps, one at each side of the room.

"A picture gallery, which is also used as a drawing room, is lighted by twelve overhead lamps; but when the eight lamps in the dining room are no longer wanted the current supplying them is shunted to the gallery for lighting eight addititional lamps, making twenty in all. The gallery is agreeably lighted even with the twelve lamps, and with the full illumination the pictures are seen as distinctly as in daylight.

"In the passages and stairs the lamps are for the most part used without glass shades, and present a very beautiful star-like appearance, not so bright as to pain the eye in passing, and very efficient for lighting the way.

"Each single lamp is about equal to a duplex kerosine lamp well turned up, and this, I believe, is equivalent to twenty-five candles, so that my 6 horse-power in supporting thirty-seven lamps gives me an illuminating effect equal to 925 candles. The same power applied to the production of light by the 'electric arc,' instead of by incandescence, would give vastly more light, but the arc light being only divisible to a small extent, could not be made nearly so serviceable for the distributed lighting of a house. Besides, the light produced by incandescence is free from all the disagreeable attributes of the arc light. It is perfectly steady and noiseless, it is free from harsh glare and dark shadows, it casts no ghastly hue on the countenance, and shows everthing in true colours. Being unattended with combustion and out of contact with the atmosphere it differs from all other lights in having no vitiating effect on the air of a room; in short, nothing can be better than this light for domestic use.

"I have not yet had sufficient experience of Mr. Swan's lamps to judge of their durability, but with the exception of a few that failed by overheating in my first trials I have lost none since I began to use them about a month ago. They have not, however, been in constant use during that time, and the test of their duration remains incomplete; but, whatever their durability may be at present, it is almost certain to be increased by progressive improvement in manufacture, and when they are systematically made in large numbers the cost of renewing them will probably be small.

"The lamps are connected with the main leading wire by branch wires, in what is called 'multiple arc,' so that if one fails the others are unaffected. To connect them in 'series' would have some advantages, but would require a much greater electro-motive force to drive the current through, and this would probably involve some difficulty.

"It is important to the preservation of the lamps that the amount of motive power applied should always be proportioned to the number of lamps in light at one time. In my case I escape the necessity of varying the motive power by using a resistance coil to represent the resistance of each section of lamps which it is desirable to have the option of throwing out of use. By means of these coils the number of lamps in light at one time may be greatly varied without affecting the work of the generator, because the resistance to the current is the same, whether it passes through the coils or the lamps. This method is wasteful of power, but I can afford to waste that which costs me nothing, and is always sufficient in quantity. If steam or gas engines were employed the case would be different, and there might be difficulty in effecting such momentary adjustments of power as would save the lamps for disturbance, where the number in use was liable to great and sudden variation.

"In the daytime the turbine and generator are occasionally used for the transmission of motive power to a second dynamo machine acting as a motor to drive a sawing machine. This it does with good effect, but I am not prepared to say how much of the original power is realised, or what should be the proportions between the generator and the motor to give the best effect.

"W. G. Armstrong.

"Craigside, Rothbury, January 17th."

"Punch" on the Telegraph Monopoly.—"The Telegraph Monopoly—popularly known as the Post Office—is proving, if any proof were needed, that no Government can be trusted. Tory, Conservative, Liberal, or Radical, are all alike when the law gives them, or leads them to believe that it has given them, unlimited powers as traders. The so-called Post Office, having made a bad and improvident bargain with the Telegraph Companies, is determined to burke invention, and earn an evil reputation as the champion of everlasting stagnation. The impertinent inventors of the Telephone have been made aware of this in a court of law, and are now made even more bitterly aware of it in their subsequent negotiations with the Government. In the first place they are told they must be taxed, and this is a communication they can hardly be astonished at. Nearly every living thing in this country is taxed, except vermin—the child in its cradle, the dying-man on his bed. The only thing practically exempt is the corpse in its coffin. However sluggish the Government may be, the tax-gatherer is superhumanly active. A Government that once taxed the light of heaven can see no injustice in taxing a telephone wire. In the second place, the impertinent inventors are told that their *radius* must be limited." &c., &c., &c.

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TELEGRAPH MONOPOLY IN AMERICA.

The ignorant outcry with reference to the telephone against the State monopoly of telegraphs in this country received a striking rebuke in the action of Continental Governments. The more perverse, if less ignorant, objectors to any form of telegraph monopoly are receiving their final rebuffs just now from the one remaining country where free competition was supposed to be permanent, and its fruits an ever-standing reproach to us. Our illiberality in giving telephonic competition a fair chance in the law courts has had its fitting commentary in the peremptory suppression of similar pretensions elsewhere; and now from America we learn that the telegraphs are at that stage of their existence when Government interference becomes a certainty. We say interference, for the amalgamation of the two great companies, the American Union and the Western Union, has already established a monopoly which is none the less real for being in private hands.

These gigantic corporations had gradually absorbed all formidable competitors, and we believe that the Rapid Telegraph Company—not a large or very promising concern—and the Telephone Companies are the only telegraphs maintaining an independent existence. Their fate may be safely predicted. If their rivalry prove inconvenient to the promoters of amalgamation, or if their absorption will further the ultimate aims of speculators, we may confidently assert that no scruples in respect to the value of competition will stand in the way of perfecting the monopoly. In any case the country is at the mercy of a few big capitalists who are quite alive to the fact that a country so situated very soon comes to terms with the enemy. To work a monopoly is profitable, but to sell it at your own price is still better. It is possible to work a monopoly so that its purchase becomes a national obligation, and the people of the United States will be fortunate if they escape this form of coercion. Probably there will be no necessity for it. The rapid and enormous rise in the prices of these telegraph companies' shares may be taken as pointing to the expectation of a Government purchase not very remote. With the outcry which is now being raised against this "bulling" of the market we are not concerned; it betokens a phase of stockbroking morality unhappily not confined to America, though more prevalent there, perhaps, than elsewhere. What is more to the purpose is the probably exorbitant price which the State will have to pay for waiting a little too long. Capitalists, like armies, may be beaten in detail, and ought not to be allowed to concentrate. If any sentimental regard for free competition has restrained them so far, possibly the sudden springing of this amalgamation mine will cure the American people of their superstition. Whether monopoly be good or bad, it is obvious that, if monopoly there must be, it is better it should be wielded by the State for the benefit of the people than by private indiduals for the earning of fat dividends. The United States have experienced some of the effects of private monopoly already in the case of their Telephone Companies. We believe we are correct in saying that the price of telephonic communication has about doubled since their amalgamation; and there is nothing to prevent a similar extortion in respect to ordinary telegrams now that their transmission is virtually in the hands of one set of men. All this, it may be said, tells against monopoly in the abstract; but we venture to point out that it tells more in favour of the view that, in respect to the signalling of telegrams, as to the carrying of letters, a united organisation and administration are, sooner or later, a social necessity. So far from being behind our neighbours in this respect, as has been said so often of late, events are showing that we are in reality a long way ahead.

We have often been twitted with our inferiority to America as regards new inventions, and progressive telegraphy in general. We have always been sceptical on one at least of these points, for the plain reason that, whatever the merits of the inventions, the speed of telegraphy was as high in this country as in any other, and a vast deal higher than in most. Some of the American inventions are known to have been adopted by us, and it is fair to assume of the rest, that if they do not beat us on their own ground they are not worth trying here. But the question that naturally occurs to us in connection with the change now impending over American telegraphy is whether anybody supposes that invention will be stifled in consequence? We do not for a moment believe it. What may take place will probably be what has taken place here. There will be far less parade over every novelty that an ingenious people may devise. The *quasi* scientific and intensely pictorial American Press may suffer somewhat, it is true; but the public are not likely to be the losers by the rejection of meretricious inutilities. If the people who are continually lamenting the decline of invention in this country had their own way, they would, we suppose, have a new company started for every new device. In kindness to the inventor, and in honesty towards his patrons, we think it far preferable that there should be a public department already in existence where the invention, if there is anything in it, can be tested and proved in practice at once. This would have prevented many abortive enterprises in America, though it has detracted from the credit of Govermental administration here, because of its seeming opposition to improvement. Governments, as a rule, do a good deal of improvement on their own

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account, and make no fuss about it. It is probably this reticence which gives rise in some minds to the impression that nothing is ever being done. The fact is that where a monopoly exists, no matter what its character may be, improvement is a process of *growth*; and it would be difficult to prove that a process which expands and adapts itself to circumstances as they arise is not quite as good as any that could be substituted in the shape of experimental innovations.

The only serious charge that could be brought against monopoly of this kind would be wilful rejection of a really useful novelty. A writer in an evening contemporary only last week commenting on the superiority of the American telegraphs—though singularly blind to the moral of the events we have been commenting upon—told his readers that in France the privileges of outsiders are safeguarded by a "non-official" body whose duty it is to pronounce upon new inventions. Perhaps the writer imagines that when American telegraphs are monopolised by the State, as they are in France, some such safeguard will be adopted there. But we should like to know what a "non-official" body of that kind really is. Is it a body of experts? If so they would be better employed in serving the State in their own capacity as experts; and in any case we do not see how they can be employed by the State in such a capacity and yet be "non-official." No such body is either practicable or desirable; and when the United States has followed the example of European nations in taking possession of its telegraphs for the good of the people at large, it will undoubtedly imitate them in their mode of dealing with inventions. If good, they will be considered; if useless, no regard for its reputation as an inventive nation will induce it to adopt them. In this country, at all events, inventors have still a wide field for their ingenuity. The railways alone have systems of telegraphy approaching in magnitude that of the Post Office itself; and our submarine telegraphy is almost entirely in private hands. No man, therefore, can deny that he has opportunities for submitting any invention that can bear the test of a public trial. We have no doubt the same facilities will survive in America, and we cannot but congratulate our cousins on what we believe will prove to be for them, as, on the whole, State monopoly of the telegraphs has been for us, a national benefit.

INSTITUTION OF MECHANICAL ENGINEERS.

M. ARTHUR ACHARD ON TRANSMITTING POWER TO A DISTANCE.

At the late meeting of this institution the above-mentioned paper was read and discussed. M. Achard, in the first part of the paper, considered the use of wire ropes; then he discussed the use of compressed air and pressure water, dealing with electrical transmission at the close. The following extract from the paper gives that part interesting to our readers:—

However high the efficiency of an electric motor may be, in relation to the chemical work of the electric battery which feeds it, force generated by an electric battery is too expensive, on account of the nature of the materials consumed, for a machine of this kind ever to be employed for industrial purposes. If, however, the electric current, instead of being developed by chemical work in a battery, is produced by ordinary mechanical power in a magneto-electric or dynamo-electric machine, the case is different; and the double transformation, first of the mechanical force into an electric current, and then of that current into mechanical force, furnishes a means for effecting the conveyance of the power to a distance. It is this last method of transmission which remains to be discussed. The author, however, feels himself obliged to restrict himself in this matter to a mere summary; and, indeed, it is English physicists and engineers who have taken the technology of electricity out of the region of empiricism and have placed it on a scientific and rational basis. Moreover, they are also taking the lead in the progress which is being accomplished in this branch of knowledge, and are best qualified to determine its true bearings. When an electric current, with an intensity i is produced, either by chemical or mechanical work, in a circuit having a total resistance, R, a quantity of heat is developed in the circuit, and this heat is the exact equivalent of the force expended, so long as the current is not made use of for doing any external work. The expression for this quantity of heat, per unit of time, is Ai^2R; A being the thermal equivalent of the unit of power corresponding to the units of current and resistance, in which i and R are respectively expressed. The product i^2R is a certain quantity of power, which the author proposes to call *power transformed into electricity*. When mechanical power is employed for producing a current by means of a magneto-electric or dynamo-electric machine—or, to use a better expression, by means of a *mechanical generator of electricity*—it is necessary in reality to expend a greater quantity of power than i^2R in order to make up for losses which result either from ordinary friction or from certain electro-magnetic reactions which occur. The ratio of the quantity i^2R to the power W actually expended per unit of time is called the efficiency of the generator. Designating it by K, we obtain $W = \frac{i^2R}{K}$. It is very important to ascertain the value of this efficiency, considering that it necessarily enters as a factor into the evaluation of all the effects to be produced by help of the generator in question. The following table gives the results of certain experiments made early in 1879, with a Gramme machine, by an able physicist, M. Hagenbach, Professor at the University at Basle, and kindly furnished by him to the author:—

Revolutions per minute	935	919·5	900·5	893
Total resistance in Siemens' units	2·55	3·82	4·94	6·06
Total resistance in absolute units	$2·435 \times 10^9$	$3·648 \times 10^9$	$4·718 \times 10^9$	$5·787 \times 10^9$
Intensity in chemical units	17·67	10·99	8·09	6·28
Intensity in absolute units	2·828	1·759	1·295	1·005
Work done i^2 R absolute units	$1948·6 \times 10^7$	$1129·2 \times 10^7$	$791·3 \times 10^7$	$584·9 \times 10^7$
Work done i^2 R in kilogm	198·6	115·1	80·66	59·62
Power expended in kilogm	301·5	141·0	86·25	83·25
Efficiency per cent.	65·9	81·6	93·5	71·6

M. Hagenbach's dynamometric measurements were made by the aid of a brake. After each experiment on the electric machine, he applied the brake to the engine which he employed, taking care to make it run at precisely the same speed, with the same pressure of steam, and with the same expansion, as during the experiment. It would certainly be better to measure the force expended during, and not after, the experiment, by means of a registering dynamometer. Moreover, M. Hagenbach writes that his measurements by means of the brake were very much prejudiced by external circumstances; doubtless this is the reason of the divergences between the results obtained. About the same time Dr. Hopkinson communicated to this institution the results of some very careful experiments made on a Siemens machine. He measured the force expended by means of a registering dynamometer, and obtained very high co-efficients of efficiency, amounting to nearly 90 per cent. M. Hagenbach also obtained from one machine a result only a little less than unity. Mechanical generators of electricity are certainly capable of being improved in several respects, especially as regards their adaptation to certain definite classes of work. But there appears to remain hardly any margin for further progress as regards efficiency. Force transformed into electricity in a generator may be expressed by $i\,w\,M\,C$; w being the angular velocity of rotation, M the magnetism of one of the poles, inducing or induced, which intervenes, and C a constant specially belonging to each apparatus, and which is independent of the units adopted. This constant could not be determined except by an integration practically impossible; and the product M C must be considered indivisible. Even in a magneto-electric machine (with permanent inducing magnets), and much more in a dynamo-electric machine (inducing by means of electro-magnets excited by the very current produced) the product M C is a function of the intensity. From the identity of the expressions i^2R and $i\,w\,M\,C$ we obtain the relation $M\,C = \frac{iR}{w}$, which indicates the course to be pursued to determine experimentally the law which connects the variations of M C with those of i. Some experiments made in 1876 by M. Hagenbach on a Gramme dynamo-electric machine appear to indicate that the magnetism M C does not increase indefinitely with the intensity, but that there is some maximum value for this quantity. If, instead of working a generator by an external motive force, a current is passed through its circuit in a certain given direction, the movable part of the machine will begin to turn in an opposite direction to that in which it would have been necessary to turn it in order to obtain a current in the aforesaid direction. In virtue of this motion the electro-magnetic forces which are generated may be used to overcome a resisting force. The machine will then work as a motor or receiver. Let i be the

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intensity of the external current which works the motor, when the motor is kept at rest. If it is now allowed to move, its motion produces, in virtue of the laws of induction, a current in the circuit of intensity i_1, in the opposite direction to the external current; the effective intensity of the current traversing the circuit is thus reduced to $i - i_1$. The intensity of the counter current is given, like that of the generating current, by the equation $i_1^2 R = i_1 w_1 M_1 C_1$, or $i_1 R = w_1 M_1 C_1$, the index $_1$ denoting the quantities relating to the motor. Here $M_1 C_1$ is a function of $i - i_1$, not of i. As in a generator the force transformed into electricity has a value $i w M C$, so in a motor the force developed by electricity is $(i - i_1) w_1 M_1 C_1$. On account, however, of the losses which occur, the effective power, that is the disposable power on the shaft of the motor, will have a smaller value, and in order to arrive at it a co-efficient of efficiency K_1 must be added. We shall then have $W_1 = K_1 (i - i_1) w_1 M_1 C_1$. The author has no knowledge of any experiments having been made for obtaining this efficiency K_1. Next let us suppose that the current feeding the motor is furnished by a generator, so that actual transmission by electricity is taking place. The circuit, whose resistance is R, comprises the coils, both fixed and movable, of the generator and motor, and of the conductors which connect them. The intensity of the current which traverses the circuit had the value i when the motor was at rest; by the working of the motor it is reduced to $i - i_1$. The power applied to the generator is itself reduced to $W - \frac{(i - i_1) w M C}{K}$. The prime mover is relieved by the action of the counter current, precisely as the consumption of zinc in the battery would be reduced by the same cause, if the battery was the source of the current. The efficiency of the transmission is $\frac{W_1}{W}$. Calculation shows that it is expressed by the following equations:—

$$\frac{W_1}{W} = K K_1, \quad \frac{w_1 M_1 C_1}{w M C}, \text{ or } = K K_1 \frac{w_1 M_1 C}{w_1 M_1 C_1 + (i - i_1) R};$$

expressions in which it must be remembered M C and $M_1 C_1$ are really functions of $(i - i_1)$. This efficiency is, then, the product of three distinct factors, each evidently less than unity, namely, the efficiency belonging to the generator, the efficiency belonging to the motor, and a third factor depending on the rate of rotation of the motor and the resistance of the circuit. The influence which these elements exert on the value of the third factor cannot be estimated, unless the law is first known according to which the magnetisms M C, $M_1 C_1$ vary with the intensity of the current. Casting a retrospective glance at the four methods of transmission of power which have been examined, it would appear that transmission by ropes forms a class by itself, whilst the three other methods combine into a natural group, because they possess a character in common of the greatest importance. It may be said that all three involve a temporary transformation of the mechanical power to be utilised into potential energy. Also in each of these methods the efficiency of transmission is the product of three factors or partial efficiencies, which correspond exactly—namely, first, the efficiency of the instrument which converts the actual energy of the prime mover into potential energy; second, the efficiency of the instrument which re-converts this potential energy into actual energy, that is, into motion, and delivers it up in this shape for the actual operaions which accomplish industrial work; third, the efficiency of the intermediate agency which serves for the conveyance of potential energy from the first instrument to the second. This last factor has just been given for transmission by electricity. It is the exact correlative of the efficiency of the pipe in the case of compressed air or of pressure water. It is as useful in the case of electric transmission, as of any other method, to be able, in studying the system, to estimate beforehand what results it is able to furnish, and for this purpose it is necessary to calculate exactly the factors which compose the efficiency. In order to obtain this desirable knowledge the author considers that the three following points should form the aim of experimentalists:—First, the determination of the efficiency K of the principal kinds of magneto-electric or dynamo-electric machines working as generators; second, the determination of the efficiency K_1 of the same machines working as motors; third, the determination of the law according to which the magnetism of the cores of these machines vary with the intensity of the current. The author is of opinion that experiments made with these objects in view would be more useful than those conducted for determining the general efficiency of transmission, for the latter give results only available under precisely similar conditions. However, it is clear that they have their value and must not be neglected. There are, moreover, many other questions requiring to be elucidated by experiment, especially as regards the arrangement of the conducting wires, but it is needless to dwell further upon this subject, which has been ably treated by many English men of science—for instance, Dr. Siemens and Professor Ayrton. Nevertheless, for further information the author would refer to the able articles published at Paris by M. Mascart in the *Journal de Physique* in 1877 and 1878. The author would gladly have concluded this paper with a comparison of the efficiencies of the four systems which have been examined, or what amounts to the same thing—with a comparison of the losses of power which they occasion. Unfortunately, such a comparison has never been made experimentally, because hitherto the opportunity of doing it in a demonstrative manner has been wanting, for the transmission of power to a distance belongs rather to the future than to the present time. Transmission by electricity is still in its infancy; it has only been applied on a small scale and experimentally. Of the three other systems, transmission by means of ropes is the only one that has been employed for general industrial purposes, whilst compressed air and water under pressure have been applied only to special purposes, and their use has been due much more to their special suitableness for these purposes than from any considerations relative to loss of power. Thus the effective work of the compressed air used in driving the tunnels through the Alps, assuming its determination to be possible, was undoubtedly very low; nevertheless, in the present state of our appliances it is the only process by which such operations can be accomplished. The author believes that transmission by ropes furnishes the highest proportion of useful work, but that as regards a wide distribution of the transmitted power the other two methods, by air and water, might merit a preference.

In the discussion on the paper Mr. Shoolbred directed attention to the work of Dr. Hopkinson and Mr. Gray, also to electrical railways, at Dusseldorf, Brussels, &c., as giving more information and experience on the subject matter of the latter part of the paper.

THE ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED).

The ordinary general half-yearly meeting of the proprietors of the above Company was held on the 4th inst., at the City Terminus Hotel, under the presidency of the Right Hon. Viscount Monck, the Chairman of the Company.

The SECRETARY (Mr. T. H. Wells) read the notice convening the meeting, and subsequently the minutes of the last half-yearly meeting, and of the extraordinary meeting held on the 14th ult. The report of the Directors was taken as read.

The CHAIRMAN stated that the resolution he had to propose, owing to the circumstances in which they were placed, was of rather an unusual character, and he would, therefore, at once read it. It was as follows:—"That the report of the Directors, and accompanying statement of accounts to the 31st of December, 1880, submitted to this meeting, be, and the same are hereby received and adopted, and that, subject as hereinafter, the following dividends, all free of income-tax, be now declared—that is to say (1): a balance dividend of 15s. per cent. upon the ordinary consolidated stock for the half year ending the 31st of December, 1880, making, with the previous payments, 3¼ per cent. on that stock for the year 1880; (2) a balance dividend of £1 per cent. upon the preferred stock for the year ending the 31st of December, 1880, making, with previous payments, 6 per cent. upon that stock for the year 1880; (3) a first and final dividend of ½ per cent. upon the deferred stock for the year ending the 31st of December, 1880; provided that none of the said dividends shall be payable until the Board of Directors (having regard to the proceedings in the pending action of Thorne *v.* the Anglo-American Telegraph Company (Limited) and others) resolve that the same be paid, and that, when so resolved, the said dividends be paid to the respective holders of the said stocks as registered this day." He presumed that they were aware that an action was commenced against the Board about October last by a certain Mr. Thorne in the Court of Chancery on the allegation that a sufficient sum had not been set aside by the Board for renewal fund, to prohibit the Directors from paying any dividend for the last two quarters. Before they received notice of that action they had already declared a dividend of 10s. per cent., and named the day on which it was payable. As soon as they received notice of the action they took the best legal advice which they could procure as to its effect on their action. The advice they had was that if the plaintiff succeeded in maintaining his case, the Directors might be held personally liable for any dividend they had paid. Notwithstanding that opinion, having already declared a dividend, and named the day on which it was payable, the Directors, strong in their conviction of the justice of their case, and also from an unwillingness to produce inconvenience to the shareholders, took on themselves the responsibility and risk of paying that dividend [cheers]. They would, however, see that the propriety of paying that dividend stood on a very different basis from that of the dividend they now asked the proprietors to approve. He did not think any shareholder would consider it reasonable, after the action referred to had commenced, and in face of the professional advice they had received, to ask the Directors to incur the additional responsibility of paying this dividend. They had, however, declared it as a Board, and they asked the proprietors to confirm the declaration, and the money would be paid immediately the action was decided in the Company's favour, or they obtained the consent of the Court; or they would pay it if they were satisfied that they were not incurring personal responsibility. Circumstances had occured within the last two or three days which led him to hope that the payment of the dividend would not be deferred for any long time. The action had been

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brought against them by a gentleman who, he believed, was possessed of a money value of about £16 in the property of the Company [shame]. He thought he was justified in saying that it was a very extraordinary state of the law that an individual possessed of such an interest as he had mentioned should be able to hang up a great public company like that for several months. This Company, however, was not single in its liability in respect to this state of the law—the same thing might, he believed, be done with the Bank of England. He thought that companies such as theirs had a right to claim that some protection should be given to them against such assaults. With respect to the general business of the Company, although he could not with truth paint everything *couleur de rose*, still he thought that there was no reason whatever for any feeling of despondency with respect to their future. As they were aware, during the past year they were engaged in a sort of internecine contest with the French Company. That contest was now brought to a termination, and one which he ventured to say was fairly satisfactory to all parties concerned. One of the results of that contest had been a lowering of their tariff. They had always maintained that the amount of their tariff which would pay them best was a question which could only be ascertained by actual trial. During their contest, as they were aware, they reduced the tariff to 6d. a word, and though the increase of messages by no means recouped them for the loss of the larger tariff, still it was productive of such results as to encourage them to reduce the 3s. tariff to 2s.; and as he mentioned at the recent extraordinary meeting that during the existence of the 2s. tariff for six or eight weeks the receipts had been as large—indeed slightly larger—than under the 3s. tariff in the previous year, and it was right to state that the receipts last year under the 3s. tariff were by far the largest receipts they had ever had. The last three or four weeks had not been quite so good, but he thought there were modes of explaining that which would commend themselves to the appreciation of all present. In the first instance, they should remember the weather of the last three or four weeks. This caused a very great suspension of business, and suspension of business meant suspension of telegraphing to a certain extent. The reduction they had, however, was not very large—about £1,000 or £2,000 a week, as well as he remembered—and this was a loss they would very soon pick up again. The receipts (he did not mean their receipts) from telegraphing across the Atlantic had risen to something like close on £20,000 a week, and a very slight cause would reduce this by 10 or 20 per cent. for a week or two. His belief was that as business increased, which they had now every right to expect, their traffic would increase in a very large proportion, and that though they had now to share with two confederates instead of one, there would in the end be room enough for them all. They could not own a very good business which was open to all the world to engage in without the very fact containing an inducement to other capitalists to embark in the same trade, with a view of obtaining a share of the gains; and rumours had reached them from the other side of the Atlantic of the construction of another line of telegraph between England and America. He hoped that, whether these rumours came to assume the aspect of reality or not, the Directors would be able to manage the business of the Company in such a way as to continue to pay, at all events, the moderate dividends which they had hitherto been able to pay. The outlay for the past year for working expenses was somewhat less than in the previous—that was, deducting the sum of £8,000 for the attempted repair of the Brest-St. Pierre cable. The period of the year at which the break took place and the tempestuous nature of the weather prevented that repair from being effected at the time it was attempted, but in the opinion of those who were best able to form a judgment on the subject there was very little doubt entertained that they would pick up and repair that cable as soon as the state of the weather justified them in sending out an expedition for the purpose. He then referred to the successful laying of the cable of 1880, as mentioned in the report, and stated that that and the other two cables continued in admirable order. The tests they received from their electricians informed them that nothing could be better than the condition of all the cables, and he trusted that they would enable the Company to continue to perform their work in a manner equal to previous years. In addition, however, to that, he had the satisfaction of informing them that, including £53,000 in spare cable, they had at that moment a reserve fund of £200,981 ready at their hands whenever they required to lay one down. He concluded by moving the resolution.

The Hon. ROBERT GRIMSTON having seconded the motion,

Mr. ASTON moved the following amendment:—"That this meeting request and authorise the Board of Directors to pay the dividends as usual, and undertake that the Company shall indemnify them against any personal liability respecting such claim."

Mr. SEELEY seconded the amendment, and asked why the large sum of £103,000, forming part of the renewal fund, was not invested. He was then handed a paper, on reading which he stated that he found that £75,000 of the amount had been invested since the report was issued.

Mr. GRIFFITH believed that it would be quite safe to act on the amendment and pay the preference dividend, but the question of paying the dividend on the deferred stock was a more difficult matter.

The SOLICITOR, referring to the discussion so far as it dealt with legal matters, thought it would not have been out of place had Mr. Aston informed him that he was going to raise the question of the validity of the meeting. He then pointed out that the report was dated the 28th ult., and was posted on that day. Excluding the day on which the notice was sent out, and including the day of the meeting, they would find that exactly seven days' notice of the meeting was given, as required by the Articles of Association, from which he quoted. He was free to confess that Mr. Aston's contention on the 131st Article was right. After reading the article he observed that it contained nothing to invalidate the proceedings of the meeting. Mr. Aston, however, stated that the meeting was not a legal meeting, but in the same breath he asked them to pass a resolution that the dividend should be paid. If the meeting were valid at all it must be valid for all purposes, and if invalid, how could they pass Mr. Aston's resolution? As to his remarks about the course taken by the Directors in reference to the action referred to, he would remind them that any shareholder could bring an action against the Company quite irrespective of the amount of stock held by him. As to compelling the plaintiff to give notice for an injunction, they had taken the advice of Mr. Horace Davey and Mr. Romer. The first observation made when the papers were before counsel was this: Has he given notice for an injunction? Our reply was: No, but he has written a letter to the Directors, stating that if after service of the writ any dividend was paid the Directors would be held personally responsible. Counsel then said that he had been well advised, for he by this means got all the benefit of an injunction without giving an indemnity for damages. But what was the use of their having damages against the plaintiff in this case? At present the state of the law was such that they could not bring this writ before the Court and get a decision till they went before the Court in the regular way, and there were no means of compelling a man to bring on an action earlier than the forms required. Every effort had been and would be made to bring the question to an issue at the earliest possible moment. The Chairman, however, had stated that they believed—and he also believed—that the dividends would very shortly be paid.

The CHAIRMAN, before replying to other questions and observations, expressed a hope that the solicitor had satisfied the meeting that they were legally convened. It appeared to him that Mr. Burt had absolutely settled the legal question. As to the amendment requesting the Directors to pay the dividend, Mr. Aston, in a very chivalrous manner, offered to give his personal guarantee against any liability they might incur by so doing; but, judged by the ordinary indications of public feeling at such assemblies, he did not think the meeting was by any means unanimous on the point; and he did not think it would be fair to the shareholders to expect them to give the Directors an indemnity any more than it would be to expect the Directors to incur personal responsibility. The solicitor had told them in a very significant manner that he did not think the payment of the dividend would be very long postponed. He thought they all understood what that meant. As to the cost of the cables and their present value, Mr. Aston had told them that he was a young shareholder, and he thought that gentleman's remarks on the subject would satisfy most of the proprietors that he was a very young shareholder in a company like this. It would be impossible to estimate practically the value of their cables at the bottom of the sea. Except to a company like their own they had absolutely no value. What they had to ascertain in order to meet the allegation against them in the action in question was this—Were they by means of their plant in as good a position for earning dividends now as they were ten years ago, or whatever time the party to the action chose to start from? Well, they had three cables working in the most admirable manner, and transacting the business of the Company as well as it was possible to do it. They were all comparatively new, too. When engaged to their amalgamation with the old French Company they had only three cables—their own two and the one of the French Company—whereas now they had four, because there was every probability that the French cable would be repaired. Their cables were not only in good condition, but they had more now than then, without any increase of their stock. The cables they had recently laid, too, the three now in existence, were of improved type, they had the benefit in their construction of all the advantages derived from previous working, and his belief was that they would last very much longer than any of the previous cables. They would publish the daily traffics shortly, but the truth was that they had only that day sealed the agreement with the French Company. He then put Mr Aston's amendment as that gentleman declined to withdraw it, but only three hands were held up in favour, and subsequently the original resolution was carried with one dissentient.

On the motion of the CHAIRMAN, seconded by the Hon. R. GRIMSTON, Sir JAMES ANDERSON was re-elected to his seat at the Board, as was Mr. Wm. Barber, on the motion of the CHAIRMAN, seconded by Sir JAMES ANDERSON.

Mr. ASTON next moved and Mr. YETTS seconded the re-election of Messrs. Joshua Dean and Francis Glass as the auditors of the Company.

On the motion of Mr. ASTON a vote of thanks was passed to the Chairman and Directors, and

The CHAIRMAN having acknowledged the compliment the proceedings terminated.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Feb. 9.		Business Done Week Ending Feb. 9. Highest.		Lowest.	
Anglo-American	60,	¼	61¼		59⅝	
Do. Preferred	88½,	¾	89⅛		88⅜	
Do. Deferred	32½,	⅝	33⅛		31⅜	
Brazil Submarine	9 15-16,	10 1-16	10		8 11-16	
Cuba Limited	8½,	9	8 13-16		8¼	
Do. Pref.	16,	16½	—		—	
Direct Spanish Limited	3,	¼	—		—	
Do. Preference	12¼,	13¼	12¼		12¼	
Direct United States C.C.	10½,	11½	11⅛		11⅛	
Eastern Telegraph	9½,	⅝	9⅝		9½	
Do. Pref.	12½,	¼	12½		12½	
Do. Debentures 1899	101,	10⅛	—		—	
Eastern Extension	10⅛,	¼	10⅛		10⅛	
German Union	9½,	10¼	10		10	
Globe Ordinary	6 7-16,	9-16	6 9-16		6 9-16	
Do. Preference	12,	¼	12¼		12	
Great Northern	10⅞,	11¼	11¼		11	
Indo-European	26,	27	26½		26½	
Mediterranean Extension	2½,	3½	3		3	
Do. Pref.	10½,	11¼	10¾		10¾	
Reuter's	10¼,	11¼	—		—	
Submarine	267,	272	—		—	
West India and Panama	1 7-16,	9-16	1⅛		1⅛	
Do. 1st Preference	6¼,	¾	6⅝		6⅝	
Western and Brazilian	7⅝,	¼	7⅜		7⅜	
West. Union 7 p. Ct. 1st Mt.	122,	127	—		—	
Do. Six per Ct. Sterg.	104,	107	—		—	

TRAFFIC RECEIPTS FOR JANUARY, 1881.

Companies.	Jan., 1881.	Jan., 1880.	Increase.	Decrse
Cuba Submarine Company	2,800 estd.	3,406	—	606
Direct Spanish Telegraph Company	1,503	—	—	—
Eastern Telegraph Company	49,445	48,887	558	—
Eastern Extension Telegraph Company	29,434	28,009	1,425	—
Great Northern Telegraph Company	17,360	—	—	—

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ABSTRACTS OF SPECIFICATIONS.

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2690. IMPROVEMENTS IN THE METHOD OF CONSTRUCTING TELEGRAPHIC, TELEPHONIC, AND OTHER WIRES.—*By Charles Moseley, William Fereday Bottomley, and William Edwin Heys.—Dated 1st July*, 1880. *Price* 6*d.*

The object of this invention is to diminish or prevent the results of inductive action. In the practical application of the telephone great difficulties arise from the induction produced in the conducting wire by other contiguous currents of electricity. It is generally known that when two or more conducting wires are parallel with and contiguous to each other, and a momentary or an undulatory current is transmitted by one of the wires, then opposite and like currents are induced in the other conducting wires. Thus, in telephonic circuits it is found that sounds transmitted by one wire are reproduced in telephones inserted in circuit of any of the adjacent parallel wires; on the other hand, in ordinary telegraphic circuits, a proportionably increased battery power being required to influence the less delicate apparatus, increased induction and consequent retardation occurs. In carrying out this invention a return wire is preferred. Each wire is carried alternately over and under the supporting arms or brackets, and also alternately to the outer and

2690 FIG. 1

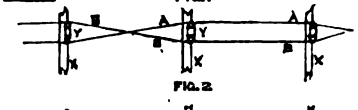
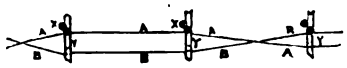


FIG. 2



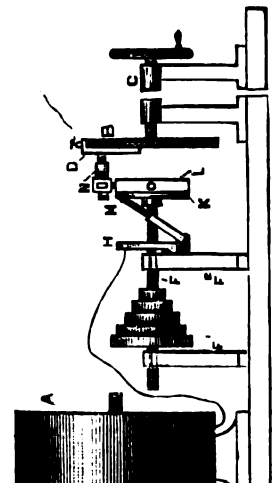
inner portions of the said arms or brackets, so that the position of the wire on one arm or bracket differs from the position of the same wire on the preceding or following arm or bracket. If required we may secure reversals of position of the wires in shorter distances by the insertion in each span of one or more riders or separators of porcelain or other non-conducting material. Fig. 1 shows in elevation, and Fig. 2 in plan, the method adopted in erecting a line. The insulators are placed one above and one below the arm, two to each arm; the first insulator may be placed above the arm near the pole, and the second insulator below the outer end of the arm; on the second arm the insulator near to the pole is placed below the arm, and the one further from the pole above the arm. All the other insulators in the line are placed in the same relative positions; thus the insulators on the third, fifth, and seventh arms, and all odd numbers, are the same as those on the first arm, and the fourth, sixth, eighth, and all even numbers the same as the second.

2835. IMPROVEMENTS IN ELECTRIC SIGNALLING AND CONTROLLING APPARATUS FOR TRAINS. *By G. W. von Nawrocki.—Dated 9th July*, 1880.—(*A communication by T. Balukiewicz, St. Petersburg.*) 4*d. Not proceeded with.*

The electric current necessary for the working of signal and controlling apparatus for railway trains is generally produced by a magnet, electric, or dynamo electric machine, which is placed either in the guard's van, just behind the locomotive, or is driven by one of its running axles in such a manner that the current is produced during the running of the train, and by suitable circuits in the train and on the line to and fro signals can be given between the officials themselves of the train, between the passengers and officials, as well as from the train to the line and the station for controlling the trains, and *vice versâ*. The machine for the production of the electric current is placed in the carriage immediately behind the locomotive, and is worked by suitable transmissions from one of the running axles. From the first cramp of the induction machine a circuit, 1, leads to one of the running axles and thence through the rails to the earth; from the second cramp another circuit, 2, leads to a cramp of the signal (ringing) box in the guard's compartment. This cramp is in communication with the twists of the electro magnet of the signal box, the wire leaving the magnet being conducted to the contact screw and previously to a second cramp of the signal box. The armature of the electro magnet is connected with a third cramp, and when at rest the connection between it and the contact screw will be broken, as the armature will be drawn by the electric current of its magnet. From the second and third cramps, circuits lead to the plates 2 and 3 of the commutator, whilst from the plates 1 and 4, circuits 3 and 4 lead to the signal works on the locomotive, and through the passenger carriages which follow the guard's van to the earth. Means are provided at suitable places in the passenger carriages for breaking the circuit 4; when this is done at any point the armature of the electro magnet will be withdrawn and make contact with the contact screw.

234820. APPARATUS FOR DISTRIBUTING CURRENTS TO ELECTRIC LIGHTS. *By George Sweange, Montreal.—Dated 30th August*, 1880.

The claims of the inventor in this case are that:—The combination of the disc B, provided with points of contact, D, and rest, C, with the disc K, provided with hollow rib, L, carrying spindle, M, provided with box, N, and contact maker, R, as shown; also the combination of the shaft F provided with disc, K, carrying armature, R, with the disc H, having rib, S, carrying spindle, M, and box,

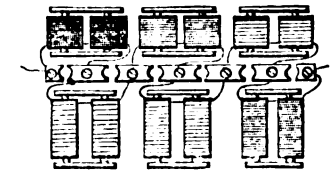


N, provided with contact maker, R, and with movable disc, B, having points of contact, D, as shown; and the generator A, in combination with a stationary disc, H, provided with a swinging contact maker, the revolving disc K, also provided with a swinging contact maker, and movable disc, B, provided with points of contact, D, as described in the figure, effect the object of the invention as above.

236321. DUPLEX TELEGRAPH, *Joseph E. Fenn, Elizabeth, N.J., assignor to the Western Union Telegraph Company, New York.—Filed October 28th*, 1880.—(*No model*).

Claim.—(1) The combination, substantially as hereinbefore set forth, of a duplex telegraph apparatus and a main line, with a bar of soft iron having its ends so connected that it will form a closed magnetic circuit, and a coil or helix enveloping said bar, or a portion thereof, which coil is included in the main circuit at a point between the main line and the receiving instrument. (2) The combination, substantially as hereinbefore set forth, of two or more detached and independent cores or bars of soft iron, of equal, or substantially equally, magnetic length, and each forming a closed magnetic circuit surrounded by

236 321

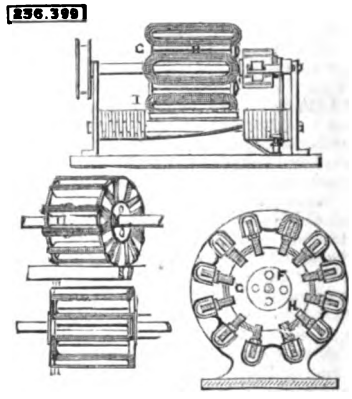


a series of helices having unlike numbers of convolutions respectively, and a commutator, whereby the helices surrounding any one or more of said independent cores or bars may be included in or cut out of a circuit. (3) The combination, substantially as hereinbefore set forth, of two or more detached and independent cores or bars of soft iron of different magnetic lengths, surrounded by a series of helices having an equal, or substantially equal, number of convolutions, and a commutator, whereby the helices surrounding any one of said independent cores or bars may be included in or cut out of the circuit.

236399. MAGNETO-ELECTRIC MACHINE, *Alfred G. Holcombe, New York, and John N. Crandall, Norwich, Conn.—Filed January* 23*rd* 1880.

Claim — (1) A magneto-electric machine in which the whole induced conductor, wound to and fro longitudinally on a cylindrical armature, and having no pole pieces projecting between its sections, is in one circuit, with only two free ends, in combination with a series of field magnets, substantially as and for the purpose hereinbefore set forth. (2) The armature of a magneto-electric machine, composed of the discs or rings G, with or without the brass hubs F and bars H, in com-

236.399



bination with the conductor I, wound longitudinally to and fro thereon, and secured to the bars H, substantially as set forth. (3) An armature for a magneto-electric machine, composed of a magnetic cylinder, either solid or with interstices, having a conductor wound to and fro on the face or faces thereof, in one circuit, with only two free ends, with no pole pieces projecting between the sections of the conductor, substantially as and for the purposes hereinbefore set forth.

INDIA RUBBER, GUTTA PERCHA AND TELEGRAPH WORKS COMPANY (LIMITED).

The ordinary general meeting of the above Company was held on the 9th instant, under the presidency of Mr. George Henderson.

The SECRETARY (Mr. W. J. Tyler) read the notice convening the meeting, and the report of the directors, which was published in *The Electrician* last week, was taken as read.

The CHAIRMAN observed that the report showed the position of the Company, which he trusted the shareholders would agree with the directors was highly satisfactory. Their general business had become so materially increased, that finding themselves cramped for room it became necessary to erect new buildings at Silvertown and to add to their machinery, but no expense had been incurred which was not absolutely essential. The carrying capacity of the steamship "International" had also been considerably increased, and the vessel herself had been rendered a better sea boat. These several items accounted for the increase of about £9,000 in the value of their property over the figures they found in previous annual accounts. The "Dacia" and the "International" were at present employed in laying cables in the Gulf of Mexico, and they would be glad to hear that they had already successfully accomplished more than half of their work. Although they could hardly expect their machinery to be always employed, they could not complain of want of occupation for it during the past year. Their works at Persan-Beaumont had shown fair results, although there was still room for more work, and that department of their business had the careful attention of the directors and the manager. The only other matter about which he need trouble them was one personal to the directors, and that was the subject of their remuneration. At the general meetings held in 1871 and 1872 this was fixed at £5,000 per annum, subject to revision by the shareholders, but there had as yet been no revision by them. For five out of the ten years which had since elapsed no dividend was paid, and the directors declined to accept any fee. When a dividend was paid the

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directors accepted their remuneration. After the accounts had been passed they would submit the following resolution for their consideration:—"That from the present year, subject to revision by the shareholders in general meeting, the directors' remuneration shall be £2,000 per annum, and that whenever the shareholders shall receive a dividend of not less than 10 per cent., the directors shall be entitled to additional remuneration of 10 per cent. on any profits earned in excess of the sum required for payment of a 10 per cent. dividend, but that in no case shall the remuneration exceed the sum of £5,000." He then moved the adoption of the report and accounts, and the payment free of income-tax of a dividend for the past half year of 15s. per share, being at the rate of 15 per cent. per annum.

Mr. S. W. SILVER having seconded the motion,

Dr. SAUL thought that the results of the working of the past year must be highly satisfactory to the shareholders. As to the remuneration of the directors he brought the matter forward last year, and he was very glad to see that the directors had taken it, as they had, into their own hands. He thought the proposal referred to by the chairman was a very fair one.

Mr. W. HANCOCK expressed his satisfaction with the report. The Company had passed through great changes in the last seventeen years, and it afforded him special gratification to see that they had at last got out of their difficulties, and had gone on earning profits which he had always contended they should earn. He approved the policy of making a strong reserve fund, and observed that in such companies as theirs this subject was of more importance than was supposed in some quarters. With respect to the remuneration of the directors, he stated that he made the proposal which was now brought before them some five, six, or seven years ago ["No, no."] He repeated that this was the case. He remembered basing his proposal on the lines that the remuneration should be a percentage, but should not amount to more than £5,000 a year; and he made this suggestion because the system had been found to work well in another company. He considered the proposal now made was perfectly reasonable, but thought it should be subject to revision in the event of a reconstruction of the capital, or £100,000 or so being added to the capital.

The CHAIRMAN remarked that the proposal would of course be subject to revision in the event of the capital being increased.

Mr. HANCOCK asked whether interest had since been received on the West Coast of America Company's debentures.

The CHAIRMAN replied in the negative.

Mr. HANCOCK said they were in the dark with regard to this matter, and all the information they had was what they obtained through the newspapers.

The CHAIRMAN observed that the directors themselves had only such information as they found in the newspapers.

Mr. HANCOCK said he was glad to see that the shares of the West Coast of America Company, which at one time represented no commercial value, were now assuming a good position in the market.

Dr. BEATTIE observed that with regard to the proposal to be submitted for remunerating the directors, the suggestion of Mr. Hancock some years ago was far more favourable.

After some further remarks on this subject the motion was put and carried unanimously.

Mr. J. O. HANSON then moved a resolution proposing the remuneration of the directors in the manner mentioned. For his own part, however, he did not think the amount was sufficiently large.

Mr. C. E. LEGGE, in seconding the motion, went into details relative to the remuneration received by the directors since the formation of the Company, and showed that it had averaged between £2,400 and £2.500 a year. He alluded to the great pecuniary responsibilities which the directors in past times had taken on themselves in order to get the Company out of its difficulties.

Mr. Alderman RANDALL supported the resolution, which was carried unanimously.

The CHAIRMAN warmly thanked the shareholders, and assured them that the board would do all in their power to promote the permanent future prosperity of the Company. He then warmly eulogised the services of the manager.

The retiring directors having been re-elected,

Mr. SILVESTER considered that they ought not to separate without cordially thanking the general manager and the staff, who must have worked hard.

Mr. L'AMY seconded the resolution.

The CHAIRMAN, who endorsed the remarks of Mr. Silvester, supported the motion, which was carried unanimously.

Mr. GRAY returned thanks, and alluded to the very uphill work they had had, and to the constant support which he had received from the directors and the staff. The report and balance sheet showed that they were in a most prosperous condition.

On the motion of Dr. SAUL, seconded by Mr. HANCOCK, a cordial vote of thanks to the chairman and directors was passed.

The CHAIRMAN having acknowledged the compliment, the proceedings terminated.

ADDRESSES.

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Works: 4, BRIDGEWATER-STREET, BROUGHTON-RD., SALFORD.
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SLIP

NATAL.—Wires between Durban and Newcastle are now cut.

WEST INDIES.—Telegraphic communication in the West Indies is now restored.

TURKISH CABLE.—A submarine cable was a few days ago laid down between Prevesa and Scutari, along the Adriatic coast.

BARBADOES.—The cable between St. Lucia and St. Vincent has been repaired, so that telegraphic communication is restored with Barbadoes.

CEYLON.—A temporary telegraph line is to be erected between Mannar and Silavaturai for business purposes during the pearl fishing season.

THE SWAN LIGHT IN DUNDEE.—Mr. Swan's incandescent lamps were exhibited by the Naturalists' Society of Dundee at their annual *conversazione* last week.

THE FITZGERALD ELECTRIC LIGHT COMPANY (LIMITED).—A company has been registered under the above title to work the patents of Mr. D. G. FitzGerald.

SNOWSTORMS IN SCOTLAND.—Telegraphic communication on the Highland Railway is now, for the first time this winter, seriously interrupted by heavy falls of snow.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The traffic receipts of this company for the weeks ended 4th and 11th February amounted to £3,548 and £3,811 respectively.

REDUCTION IN PRICE OF GAS.—From all quarters of the kingdom we hear of a reduction in the price of gas, varying in amount, but decided in its tendency. What is the cause?

THE SWAN LIGHT AT GLASGOW.—We hear that Mr. Swan has promised to read a paper on his light before the Philosophical Society of Glasgow at an early date, when the new buildings now occupied by the society will be lighted up with his lamps.

ASHANTEE.—The Government received a demand from the Crown Agents on Saturday last for ten miles of telegraph wire with apparatus, men, and material. On Monday evening the whole equipment was in Plymouth, and on Tuesday morning it sailed for the Gold Coast.

SOUTH AMERICA.—The Western and Brazilian Telegraph Company notify the repair of their Rio Grande do Sul, Monte Video, section, and that direct cable communication is now re-established between Europe, the Argentine Republic, and the West Coast of South America.

THE ELECTRIC LIGHT AT ALNWICK CASTLE.—The initiatory experiments in lighting the castle with the aid of steam power have, we learn, been abandoned, and water-power is to be applied, through the agency of the turbine wheel, from the water of the Aln at the Abbey Mills.

AUSTRIAN TELEGRAPHS.—The returns from the Austrian Telegraph Department for December last show an increase of 22,625 messages over December, 1879; the total number sent during the former period being 372,557, the amount received for which was 251,224 florins, as against 215,123 florins received in the latter.

A PERTINENT QUESTION.—A correspondent of the Newcastle *Daily Chronicle* writes, under the head of "Sir W. Armstrong and the Electric Light":—"Sir: Referring to the paragraph in your edition of this morning, will some correspondent explain what becomes of the electric light when the brook is frozen?"—We do not know. Can anyone tell?

THE TELEPHONE IN DUBLIN.—The Secretary of the Dublin Post Office has intimated to the Corporation of that city that the proposed erection of wires in public streets by persons not authorised in the Act of 1863 is illegal. It is at the same time intimated that the Post Office is prepared to establish telephonic communication wherever this may be applied for.

TELEGRAPH CLERKS.—A memorial has been forwarded to the Postmaster-General from the third-class female telegraphists of the South-Western District, stating that they have been waiting some years for promotion, contrasting their position with that of their colleagues at the Central Office, and setting forth the footing on which they plead henceforth to be placed.

FRENCH MINISTERS AND THE TELEPHONE.—M. Jules Grévy, accompanied by M. Jules Ferry and several other Ministers, spent two hours at the Paris Bourse on Saturday evening. A number of interesting experiments were tried with the telephone and the photophone, the transmission of spoken words by means of electric rays being, it is said, especially successful.

BRIGHTON AND THE ELECTRIC LIGHT.—On Thursday evening last the electric light was employed on the Marine Parade, Brighton, for the first time, under the direction of Messrs. Siemens Brothers. The Town Council will continue the experiment for one month, with the intention of lighting the whole of the sea front by electricity should the preliminary trial result in success.

THE TELEPHONE ABROAD.—With reference to our note of last week, we have received later information saying that:—Mr. Edwin de Léon, acting as agent for Professor Graham Bell, has been authorised by the Egyptian Government to erect lines, and establish telephonic communications in Cario and Alexandria. The Government has no connection with the project beyond giving the permission to carry it out.

CABLES REPAIRED.—The Eastern Telegraph Company notifies the repair of its Falmouth-Vigo cable, thus restoring telegraphic communication with Spain, Portugal, Maderia, and South America, *viâ* Falmouth.—The Eastern Extension Telegraph Company also notify the repair of their Madras-Penang cable, thus restoring direct telegraphic communication with the Straits Settlements, China, Japan, and Australia.

RECENT TRIALS OF THE ELECTRIC LIGHT.—Last week the new Waterloo Station of the London and South-Western Railway and its approaches were illuminated for the first time with the electric light by means of fifteen lights. The experimental trial was made in the presence of the chairman, Colonel the Hon. H. W. Campbell, Captain Johnstone, Mr. Archibald Scott, general manager, and other officials of the company.

TELEPHONE AT MIDDLESBROUGH.—Telephone communication has been established between the various police-stations and the Fire Brigade Stations of this town. The instrument used is the Hunnings micro-telephone, and has been set up by Messrs. Harrison, Cox-Walker, and Co., of Darlington. The first trials were a success; indeed, Mr. Hunnings claims precedence for his instrument over the Gower-Bell and other rivals.

PRICES.—The prices of gutta percha as quoted are:—For genuine 4d. to 3s. 3d. per lb., for reboiled 3d. to 1s. 3d. per lb. India rubber, per lb.:—For Para (fine) 3s. 4d., Negrohead 2s. 3d., Central American 1s. 9d. to 2s. 4d., Assam and Pegu 1d. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 2d. There is a slight falling off in East Indian and Madagascar, the market generally is described as being flat and lower.

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Horse Killed by Lighting.—During the recent storm a valuable colt, belonging to Mr. Frank Coleman, of St. Minver, Cornwall, was struck by the lightning and killed. It is said that several sheep in the neighbourhood are suffering from partial blindness, supposed to have arisen from the effects of the lightning. On the same day the tower at Stepper Point, Padstow, was struck by lightning and split open, the masonry in the old doorway knocked down, and the ground torn up for several yards around. The lightning pierced three holes through an adjacent stone hedge, and seems to have spent its force in the adjoining field.

The Society of Telegraph Engineers and of Electricians.—The next meeting of this society will be held at the Institution of Civil Engineers, on Thursday, February 24, when the adjourned discussion on Mr. Alex. J. S. Adams's paper ("Earth Currents—Electric Tides") will take place, and, time permitting, the following papers will be read:—"On the Application of Dynamo-electric Machines to Railway Rolling Stock," by Lieut. P. Cardew, R.E., Associate; "On the Interference with the Processes of Manufacture of Wool and Hair, arising from the Development of Electricity during Spinning, with a Description of Apparatus Applied to Obviate it," by Edward B. Bright, Member.

SS. "Calabria" as a Troop-ship.—We hear that this fine cable ship is chartered by the Government from the Telegraph Construction and Maintenance Company to carry troops to the Cape. She has been measured and found capable of accommodating 200 horses and 300 men easily. She is now lying at the east end of the Victoria Docks. The "Calabria" is a steamer of 3,325 tons burden, her cable tanks are to be used to stow fodder and cargo in, and are to be planked over, a small hatchway only being left. Outsiders are not a little exercised in their minds at the height 'tween decks of this magnificent vessel, which is unusually great, being 9ft. The officers going out in her, too, will have a good time of it, as her cabins are luxuriously fitted up.

Cable Repairing.—The activity of the cable companies during the past few weeks has been considerably exercised, and their resources fully tested. During the past six weeks no less than seven faults have been developed between England and her Eastern colonies, keeping four ships constantly employed in repairs. These repairs have all been executed, and the duplicate system between England and Australia is again complete. The absence of anything like stoppage shows how excellent is the policy that has evolved such a complete duplication of system. In fact not only was there no stoppage, but we have reason to believe the receipts of the Eastern Extension Company were actually more during the short time their alternate line was interrupted than while it was working previously.

Society of Telegraph Engineers.—The new numbers of this society's *Journal* is just issued. Amongst the contents are Mr. Swan's paper on "Subdivision of the Electric Light," Mr. Preece's on the "Photophone," the discussion on the alteration of the society's title, &c. At the end of the number are several abstracts of papers on various subjects. Whilst we congratulate the society on the appearance of these abstracts, we should be very glad to see their number extended. In the annual report of the council we notice that a general index to the volumes of the *Journal* is in hand, though, as it will probably extend to Vol. X., which is not yet published, it will be some time before it is issued. This will be a great boon to all who consult the *Journal*, and will also add greatly to its value.

A Peripatetic Message.—During the block occasioned by the late snowstorms in Scotland, the *Dundee Advertiser* says:—"Before the wire was repaired between Aberdeen and Peterhead the messages from the latter place were taking a very remarkable route. A message despatched from Peterhead, where there is a North Sea box testing apparatus and powerful batteries, passed along the North Sea cable to Egersund, where it was translated into Norwegian. Thence it was sent in circuit to Arendal and Christiania, and from the last-mentioned place transmitted to Gottenburg, in Sweden. From this point it was re-transmitted and sent on to Newcastle, where it was again turned into English. It was then despatched to Edinburgh, and thence to Aberdeen, which it reached six hours after it had left Peterhead."

New Telephone Company.—The formation is announced of the Oriental Telephone Company (Limited), with a capital of £300,000, in shares of £1. It is formed to carry out an agreement made between A. A. Bell, of the first part, T. A. Edison of the second, the Oriental Bell Telephone Company of the third, the Anglo-Indian Telephone Company (Limited) of the fourth, and Samuel Tusull on behalf of this company, and to acquire any patents, rights, privileges, concessions, &c., for the use, sale, working, and manufacture of any telephone or telephonic apparatus, or any other invention, instrument, or apparatus for the transmission of messages. The subscribers (who take one share each) are Sir Julius Vogel, 135, Cromwell-road; J. Pender, M.P., 18, Arlington-ton-street; R. R. Jackson, Preston; D. Parrish, 2, Copthall-buildings; J. S. Cooke, Gray's Inn; A. J. Macdonald, 2, Suffolk-lane; P. Carnegie, Upper Norwood; R. H. Horne, 22, Hogarth-road.

Stockport and the Electric Light.—The question of the electric light occupied the attention of the Stockport Town Council for a considerable time the other day. One member, Captain Turner, who was its advocate, came down upon the councillors with a regular volley of extracts from books and papers. Another member of his own profession (Lieut.-Colonel Wilkinson) took exactly an opposite course, and made some very slighting remarks about the light, finally winding up by exhorting the council to wait for Manchester to show them the way. This the gallant captain would not submit to; he did not at all see why they should not show the way without waiting for anyone; he pointed out that they had the water power ready to hand, which would do away with a great deal of expense. After a considerable amount of discussion, in which a lamentable want of knowledge of the subject was displayed, it was resolved to appoint a committee to inquire into the matter.

Electric Signals for Railways.—The *Scientific American*, speaking of a series of utterly inexcusable accidents that have occurred on the New York elevated railways, says:—"It is easy to make a show of shifting the responsibility upon *employés*, but so long as the companies persist in running these roads without providing electric signals, and all the other safety appliances used on our railroads, the recurrence of collisions, derailment at misplaced switches, &c., may certainly be expected. The neglect to provide electric signals is all the more culpable when the comparatively small outlay required to supply them is considered. Steps should be taken to compel the companies to provide every known means for securing the safety of the many thousands of people who daily trust their lives upon the elevated railways. Suitable legislation, which we do not believe they could successfully obstruct or defeat, should be at once begun to compel what they do not seem disposed to voluntarily perform."

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A Company for Mr. Swan's Light.—Upon terms of an agreement of 2nd inst. between Joseph Wilson Swan, of Newcastle-on-Tyne, and Robert Spence Watson, the Swan Electric Light Company (Limited) proposes to acquire and work the letters patent granted to the former for inventions in relation to lighting by electricity. The company was registered on the 7th inst., with a capital of £100,000, in £10 shares. The purchase consideration is £25,000 in cash, and 2,500 fully paid-up shares. The vendor is appointed managing director of the technical department of the company's business for fourteen years, at a salary of £1,000 per annum. The subscribers are:—Hilton Phillipson, Tynemouth, colliery owner; A. S. Stevenson, Tynemouth, chemical manufacturer; James Craig, Tynemouth, merchant; J. T. Melly, Newcastle-on-Tyne, chemical manufacturer; John Cameron Swan, Newcastle-on-Tyne, merchant; John Williamson, Southgarth, Westoe, Durham, chemical manufacturer; James Hall, Tynemouth, shipowner; R. S. Donkin, North Shields, shipowner, who take one share each. The number of directors is not to be less than five, nor more than fifteen; the first five names mentioned are the present directors, with J. C. Stevenson, M.P., and J. W. Swan.

International Electrical Exhibition.—We have received the following from M. G. Berger, Commissaire Général:—The French Railway Companies will carry goods for exhibition at a reduction of 50 per cent. on the ordinary fares, that is to say, they will charge the full fare for carrying them to Paris, but nothing for their return, excepting the charges for loading and unloading, &c. Foreign goods will be received at frontier stations if accompanied by a certificate to be furnished by the Commissaire de la Nation, or the Commissaire Général Français if a Commissaire National should not be appointed. When sending goods back after the Exhibition, the receipt stating that full fare has been paid must be produced at the Paris Station to procure the reduction above mentioned. The cost of carriage between the station and the Palais des Champs Elysées will fall on the exhibitor. Goods for exhibition will be received at the Palais after 1st July, 1881, and will not be subject to search by Customs officers until the moment of opening them at the Exhibition, neither will they be searched anywhere on the return journey. Goods that may remain in France after exhibition will have to pay Custom dues, but a special law is about to be passed under which the tax on these goods will be reduced considerably. Exhibitors will be supplied with further information on application to the Commissaire Général, Exposition International d'Eléctricité, Ministère des Postes et des Télégraphes, Paris.

International Exhibition of Electricity.—*The Times'* correspondent in Paris writes:—"There seems to be some misunderstanding in England in regard to the International Exhibition of Electricity. It is not a private enterprise, as appears to be thought in England. The French Government not only patronises it, but subsidises it to an extent which has every likelihood of sufficing for all expenses. The Government, before placing itself at the head of the Exhibition, was desirous of ascertaining the disposition of the public and of the many capitalists who are interested in the practical application of electricity. It elicited the disinterested subscription of a guarantee capital large enough in case of need to furnish all the resources necessary both for the Exhibition of Electricity and for the Congress of Electricians. The result in a few days exceeded all expectation; it even imposed on the Administration the necessity of declining a large number of offers. Here the Government intervened as above mentioned, so that the Exhibition is now as Governmental as the Congress. A certain number of English exhibitors have already addressed themselves to M. Berger, the able Commissioner-General, who has provisionally accepted their demands for admission till they can be placed in the hands of her Majesty's Commissioner on his appointment. A gentleman, moreover, is about to be sent to England with all the necessary information, which he will lay before the different scientific and industrial societies and electricians who may be disposed to exhibit. As yet the preparations have been eminently successful."

Gas v. Electricity.—On Thursday week Mr. W. H. H. Broadberry, President of the Southern District Association of Gas Engineers and Managers, delivered an address, in the course of which he made a few remarks on the electric light. As it is an acknowledged benefit to know both sides of the question, we reproduce a few of Mr. Broadberry's remarks:—"The electric light is gradually making headway, and with a few more improvements in its distributing apparatus, it will, I have no doubt, take its position as an illuminating agent, but we consider it cannot in any way lay claim to be a cheap method of illumination. We find that some extensive trials have been made at the Royal Arsenal, Woolwich, with the electric light, but the authorities do not appear to be at all satisfied with it, for they are making considerable alterations and additions to their gasworks. The electric light seems to have made the progress it has done through the desire for change shown by persons in authority. Some extensive trials of the light are to be made in the city of London, which certainly cannot be recommended on the score of economy; certain districts, which up to the present have been illuminated by about 450 gas lights at a cost of about £1,690 per annum, are to be superseded by the electric light at a cost of £8,000 for the same period. The late Phœnix Company, under the direction of our esteemed member, Mr. Corbet Woodall, and the Chartered Company, under the direction of their officers, and advised by Mr. Sugg, have shown the public some splendid arrangements for street lighting, and we think, if the improvement in street lighting had been the only object of the trials, that, in all fairness to the gas companies, they too should have had an opportunity of showing the public what they could accomplish for a like sum in the same area; or, at least, they should have had an opportunity to show what could be done at a proportionate cost according to the area of the district experimented in. As it is, I have no doubt we shall have a flaming account of the superiority of the electric light and the question of cost kept in the background. I feel bound to make these remarks, but I trust you will not think it is done on the same principle as the boy we hear about, who whistled when he was passing through the churchyard, just to keep his courage up and the evil spirits down. We read in another place and on another occasion of a certain philosopher and doctor of the law, who said, "Take heed to yourselves what ye intend to do as touching these men, and now I say unto you to refrain from them and let them alone, for if this counsel or this work be of men, it will come to nought." So would I say of these schemes; if they are for the purpose of bolstering up the electric light, or as bogies to the gas companies, they will come to nought. Our opinion of the energy of the electric light is that it is an energy expended in the wrong place, and I think I am justified in saying that there is no known method of artificial illumination that can give so much light, in proportion to its cost, as coal gas.

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GAS AND ELECTRICITY AS HEATING AGENTS.

BY DR. C. W. SIEMENS, F.R.S.

This was the subject of a lecture delivered on the 27th of January last at Glasgow, under the auspices of the Science Lectures Association. In the first portion of his lecture Mr. Siemens dealt with gas and coal, and spoke of the various methods by which more heat, better light, and less smoke might be obtained respectively. Speaking of gas, he said that by means of the various improvements in the burners and the application of the principle of conduction it would be better able to hold its position against its more brilliant rival, the electric light, except in large spaces, as railway stations, &c., and adding to this the improvements in the use of gas as a heating agent, the lecturer expressed his regret that he was not a gas shareholder. Turning to the second portion of his address, he referred to the attainment of very intense degrees of heat either for effecting fusion or chemical decomposition. Although by means of the combustion of either solid or gaseous fuel heats are produced which suffice for all ordinary purposes, there is a limit imposed upon the degree of temperature attainable by any furnace depending upon combustion.

To electricity we must look, he said, for the attainment of a higher temperature, and we have evidence of the early application of the electric arc to such a purpose. In 1807 Sir Humphry Davy succeeded in decomposing potash by means of an electric current from a Wollaston battery of 400 elements, and in 1810 he surprised the members of the Royal Institution by the brilliant electric arc produced between carbon points through the same agency.

Magneto-electric and dynamo-electric currents allow of the production of the electric arc much more readily and economically than by using Sir H. Davy's gigantic battery. My object is to show that the heat of the electric arc is not only available within a focus or extremely contracted space, but that it is capable of producing such large effects as will render it useful in fusing platinum, iridium, steel or iron, or for effecting such reactions or decompositions as require for their accomplishment an intense degree of heat, coupled with freedom from such disturbing influences as are inseparable from a furnace worked by the combustion of carbonaceous material. The apparatus which I employ to effect the electro-fusion of such material as iron or platinum consists of an ordinary crucible of plumbago or other highly refractory material, placed in a metallic jacket or outer casing, the intervening space being filled up with pounded charcoal or other bad conductor of heat. A hole is pierced through the bottom of the crucible for the admission of a rod of iron, platinum, or dense carbon, such as is used in electric illumination. The cover of the crucible is also pierced for the reception of the negative electrode, by preference a cylinder of compressed carbon of comparatively small dimensions. At one end of a beam, supported at its centre, is suspended the negative electrode by means of a strip of copper or other good conductor of electricity, the other end of the beam being attached to a hollow cylinder of soft iron, free to move vertically within a solenoid coil of wire, presenting a total resistance of about 50 units or ohms. By means of a sliding weight the preponderance of the beam in the direction of the solenoid can be varied so as to balance the magnetic force with which the hollow iron cylinder is drawn into the coil. One end of the solenoid coil is connected with the positive, and the other with the negative pole of the electric arc, and, being a coil of high resistance, its attractive force in the iron cylinder is proportional to the electromotive force between the two electrodes, or, in other words, to the electrical resistance of the arc itself.

The resistance of the arc is determined and fixed at will within the limits of the source of power by sliding the weight upon the beam. If the resistance of the arc should increase from any cause, the current passing through the solenoid would gain in strength, and the magnetic force overcoming the counteracting weight would cause the negative electrode to descend deeper into the crucible; whereas, if the resistance of the arc should fall below the desired limit, the weight would drive the iron cylinder within the coils, and the length of the arc would increase until the balance between the forces engaged had been re-established. Experiments with long solenoid coils have shown that the attractive force exerted upon the iron cylinder is subject only to slight variation within a range of several inches, which circumstance allows of a working range, to that extent, of nearly uniform action on the electric arc.

This automatic adjustment of the arc is of great importance to the attainment of advantageous results in the process of electric fusion. Without it the resistance of the arc would rapidly diminish with increase of temperature of the heated atmosphere within the crucible, and heat would be developed in the dynamo-electric machine to the prejudice of the electric furnace. The sudden sinking or change in electrical resistance of the material undergoing fusion would, on the other hand, cause sudden increase in the resistance of the arc, with a likelihood of its extinction, if such self-adjusting action did not take place.

Another important element of success in electric fusion consists in constituting the material to be fused the positive pole of the electric arc. It is well known that it is at the positive pole that the heat is principally developed, and fusion of the material constituting the positive pole takes place even before the crucible itself is heated up to the same degree. This principle of action is, of course, applicable only to the melting of the metals and other electrical conductors, such as metallic oxides, which constitute the materials generally operated upon in all metallurgical processes. In operating upon non-conductive earth or upon streams of gases, it becomes necessary to provide a non-destructible positive pole, such as is supplied by the use of a pool of fused platinum, or iridium, or by a plumbago crucible. In working the electric furnace, some time is taken up in the first instance in raising the temperature of the crucible to a considerable degree, but it is surprising how rapidly an accumulation of heat takes place. In using a pair of dynamo machines capable of producing 70 webers of current with an expenditure of 7 horse-power, and which when used for purposes of illumination produce a light of 12,000 candles, a crucible of about 8 inches in depth, immersed in a non-conductive material, has its temperature raised to a white heat in 15 minutes, and 4lb. of steel are fused within another 15 minutes, successive fusions being effected in somewhat diminishing intervals of time. The process can be carried on upon a still larger scale by increasing the power of the dynamo machines and the size of the crucibles.

The purely chemical reaction intended to be carried into effect within the crucible might be interfered with through the detachment of particles from the dense carbon used for the negative pole, although its consumption within a neutral atmosphere is exceedingly slow. To prevent this I have used, both in this connection and also in the construction of electric lamps, a water pole, or tube of copper through which a current of water circulates, so that it yields no substance to the arc. It consists simply of a stout copper cylinder closed at the lower end, having an inner tube penetrating to near the bottom, for the passage of a current of water into the cylinder, which water enters and is discharged by means of flexible india rubber tubing. This tubing being of non-conductive material, and its sectional area small, the escape of current from the pole to the reservoir is so slight that it may be neglected. On the other hand, some loss of heat is incurred through conduction, with the use of the water pole, but this loss diminishes with the increasing heat of the furnace, inasmuch as the arc becomes longer, and the pole is retired more and more into the crucible cover.

By some obvious modifications of this electric furnace it can be made available for a variety of other purposes where intense heat is required combined with immunity from disturbing chemical actions. By piercing a number of radial holes through the sides of the chamber, and introducing the ends of wires through the same, an excellent means is provided of heating those wire ends very rapidly, without burning them, for the purpose of welding them together. The electrical furnace will also be found useful, I believe, in the hands of the chemist, to effect those high temperature reactions between gaseous bodies which require the employment of temperatures far exceeding the hitherto available limits, and will thus increase the area of available reactions at his disposal for the attainment of either scientific or practical ends.

LESSONS FOR LEARNERS.

(CONTINUED FROM PAGE 127.)

I am glad to see that you have correctly measured the resistances of the various wires I left with you. We shall to-day turn our attention to another part of our apparatus, and try and find something interesting about the galvanometer. The instrument will well repay the study you may give to obtain an insight into the theory of its action, but before you can really master the theory you will have to master certain branches of mathematics pure and applied.

When Professor Oersted, of Copenhagen, found, in the first quarter of this century, that an electric current passing along a wire near to a small magnetised needle exerted some influence upon the needle, he had really found the means of measuring a current of electricity, not to mention the more valuable application of the electric current to telegraphic purposes. Oersted

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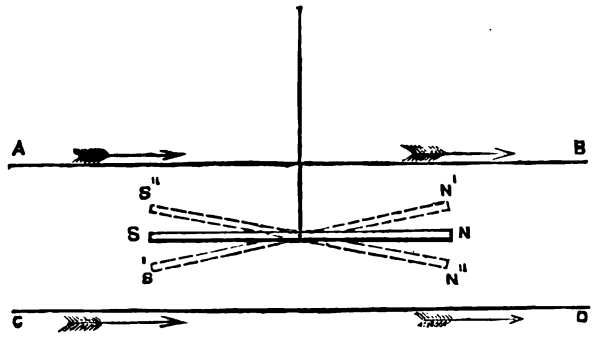
made the discovery that other men applied—here, as is almost always the case, successful application resulted from the combined labours of many workers, each modifying or extending the work of those before or contemporary with him. Ampère threw his mind into the investigation of the law which governs the influence of an electric current upon a magnet, and succeeded in formulating it in very simple language.

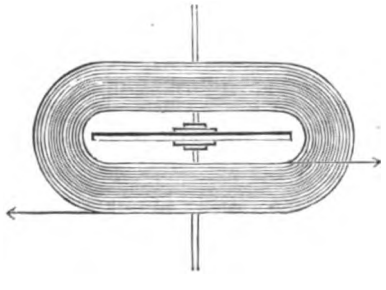


I have here a magnet, N S, which I will suspend by this silk I now arrange the wire A B a little above the magnet, connecting the wire with the battery, so that the current flows in the direction A to B. You see as soon as I make the connections the needle moves from its position of rest. I disconnect A B and join up this other wire C D below the magnet, so that the current goes from C to D, and you see the needle moves, but in a direction opposite to that in which it moved before. I again disconnect and again connect C D, but this time so that the current flows from D to C, and you notice that now the needle moves in the same direction as in the first experiment. Letting C D remain connected as it is, I again connect A B as at first, and we notice that the needle moves still further away from its normal position. We have, in fact, added the influence of A B and C D together. I will now oppose these influences by making the current pass from C to D, with the result, as you see, of bringing the needle to the position it has when no current is passing. The current in C D tries to pull it in one direction, the current in A B tries to pull it in the opposite direction, and as I have so arranged that the pulls are equal no motion occurs.

Ampère's experiments led him to express these results as follows:—

Imagine the observer facing the magnet to be so placed that the current passes through him from feet to head, then the north pointing pole of the magnet will move to the left.

Thus, in the figure, if the observer be supposed to lie face downwards on A B, with feet towards A, head towards B, the pole of the magnet marked N moves to his left, that is, towards N'. On the other hand, if he lie face upwards, with head towards C, and feet towards D, with current from D to C, the N pole of the needle will take the direction indicated by N''.



Professor Schweiger, of Halle, took advantage of the addition of the influence of the current exerted above and below. He found that on coiling the wire several times round the magnet the force exerted on the magnet increased with the number of turns. The instrument obtained by this means was called an electro-magnetic multiplier. Since the introduction of the instrument by Schweiger it has undergone long and careful investigation in the hands of electricians of the highest repute. The principle of the multiplier, however, is the principle underlying the instrument so well known to us as the galvanometer.

I must now make what will seem to be a wide digression, and you may perhaps begin to think I have forgotten all about the galvanometer, which shall for the time being be put on one side. Here are several magnetised needles, some suspended in one way some in another, and I notice one or two of you have small compasses attached to your watch-guards. Bring them here, and let us try all together. There they are, and you will notice it is no awkward squad before us. Hardly have we put them down before all turn in one direction, pointing nearly north and south. I have here another lot of needles, some magnetised and some not. I do not know which are magnets and which are not, but we shall soon see. I push them through the tops of these small corks, and put a dozen or so of the corks so provided into this shallow dish of water. You see we have a real awkward squad now. Three or four of the needles have turned towards north and south, the rest stop pretty much as they were dropped in.

Let us now gently change the position of the corks carrying the needles pointing north and south. We do so, and find them a little obstinate. They will return to their old direction. Try some of the others that point here and there, and we see they remain in the new position without any attempt to regain that from which we displaced them. Those needles that remain as placed are not magnets; those that persistently turn in the direction north and south have been magnetised.

Let us move some of these magnets on the table. You see they all return to point in one particular direction; they oscillate a little while about the normal direction, but when we are still they soon return to the position from which we displace them. When I move one of the needles from its position of rest, I use force, but the moment I take my finger away from the needle this force is no longer applied. And now, before we can learn much about the needle we must learn something about force. Professors Sir W. Thomson and P. G. Tait* say that "the science which investigates the action of force is called, by the most logical writers, *dynamics*. It is commonly, but erroneously called *mechanics*; a term employed by Newton in its true sense, the science of machines, and the art of making them.

"Force is recognised as acting in two ways:—

"1. So as to compel rest or to prevent change of motion, and

"2. So as to produce or to change motion.

"Dynamics therefore is divided into two parts, which are conveniently called *statics* and *kinetics*.

"In statics the action of force in maintaining rest, or preventing change of motion, the balancing of forces, or equilibrium, is investigated; in kinetics the action of force in producing or in changing motion."

I need hardly tell you that the professors I have quoted are the acknowledged authorities on these subjects, but, at the same time, I must warn you that their writings are a little too advanced for beginners. I would recommend an elementary book if I could, but the so-called elementary books are worse than useless, being misleading and so numerous that the task is too difficult. I may mention, however, that I once heard a very able electrician and mathematician say, that the student who used a little work on the subject by Dr. O. J. Lodge† would have less to unlearn than if he used any other book with which my informant was acquainted.

I have upon the table a little box, in which I place this weight. Hooks are screwed on to the box at the ends and the sides. At the ends of the table I fix these wheels. I now take this weight, and, by means of a string over the wheel, fasten it to the box. As soon as I let go, the box slides along the table, and now it has toppled over. What a clatter. I now similarly fix equal weights to each end of the box, and it does not move. I double the weights on each side, but we get no motion. Experiments like these show that, when equal forces act upon a body in opposite directions, they counteract each other, and no motion results.

I now take this 2lb. weight, and having put away those used previously, attach it to the box, when the end of the box touches this mark on the table. Letting the weight act, the box moves slowly, and we can note how long it takes to get to the end of the table. Those who have watches showing seconds keep time. Are you ready? Now we start. Now we stop. How long do you make it. Eight seconds. Let us alter our arrangement a little. I replace this weight by one of 4lb., putting this one at the other end. We have now 4lb. on one side and 2lb. on the other. Take the time again. Well, you make it eight seconds still. From these and far more delicate experiments we know that when two forces act on a body in opposite directions the result is just the same as if only one force was acting on the body, in the direction of the larger force. The one force is equal to the difference of the two. Thus, if a force of 16lb., tons, &c., act on a body in one direction, and a force or 9lb., tons, &c., act on the body in the opposite direction, the body behaves just as if a force of 16—9=7lb., tons, &c., acted on the body in the direction of the stronger force.

* "Elements of Natural Philosophy."

† The book referred to was noticed in *The Electrician* soon after its publication. It is published by Messrs. Chambers, of Edinburgh and London.

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THE PARIS CONGRESS AND EXHIBITION.

We understand from good authority that the arrangements, so far as Great Britain is concerned, in connection with the forthcoming Electrical Congress and Exhibition in Paris have been delegated to the officials at South Kensington. This selection is peculiarly unfortunate, because the greater number of British scientific men, amateur and professional, seem to have a very decided opinion as to the feebleness of the South Kensington machinery.

We may well ask what is the position of South Kensington in regard to electrical science. Its claims to recognition, so far as we can see, are of no striking character. It nominally pays by results for the giving of elementary lessons to artizans; but in reality a large part of this payment finds its way into such places as Manchester Grammar School, and till recently to the St. Margaret's Science School at Westminster. South Kensington also trains "teachers" by giving them a course of about "four weeks" lectures, after which these scions of the school are understood to be quite capable of "teaching science." It is a delusion to suppose for a moment that South Kensington in any shape or form represents the science of Great Britain, and we take the earliest opportunity to repudiate any suggestion that it represents the special branch of science in which we are so deeply interested. Granting that South Kensington is an educational establishment, granting that its syllabus is in strict accordance with modern requirements, granting that its work is carried on in the best conceivable manner—what then? We simply come to this, that its work is in connection with elementary education, and it does not and cannot take cognisance of scientific progress. True, South Kensington has had some experience in exhibition work—but its successes in this direction are so doubtful that except in the spending of large sums of money, they may be termed imaginary.

Our opinion is that Great Britain should be worthily represented, and every effort made to show that neither in the pure science nor in the applied science are we one jot behind the whole world combined. We have instruments of precision, based upon laws determined by our *savants*, that will bear the strictest scrutiny. We have men among us whose lives are spent in original research and investigation, and who have materials at hand to embody in papers that will not be surpassed by the scientific brotherhood of other lands. As M. du Moncel so admirably argued recently in the pages of *La Lumière Electrique*, electrical science is cosmopolitan. We do not arrogate to ourselves superiority. We do insist upon equality, and in this Conference of nations there should be a determined effort made to be represented by nothing short of the "best."

It seems to us that a committee composed of members nominated by the Royal Society, the Physical Society, the Society of Telegraph Engineers, and the Postal Telegraph Department would at once harmonise the scientific and the practical, and commend itself to all as really and truly representative. The authorities at South Kensington may show how wrong it is of us to animadvert upon their tact and ability, by nominating a committee comprising the Presidents of the Societies named and the Chief Electrician of the Postal Telegraph Department, with power to add to their number. Whatever is done should be done quickly. The men who can represent Great Britain will not wait the convenience of South Kensington before making their autumnal arrangements, and the laggard authorities may find too late how easy it is for the best laid schemes to "gang astray." The scientific press may as usual obtain its information from stray scraps let fall to the political papers, but it is doubtful if any systematic method will be adopted whereby readers can be kept fully conversant with the detailed arrangements as they are made. And yet this is what ought to be done. It is understood that almost every paper of repute has facilities for obtaining information. We maintain that together with our contemporaries *The Engineer*, *Engineering*, *Nature*, and the *Telegraphic Journal*, we should be furnished with official information on a subject which must necessarily be very interesting to our readers.

Our position is quite clear. We were many days ago informed that the communications made from France to the Postal Telegraph Department in London had by some means been transferred to South Kensington. The information may of course prove to be incorrect, but we have waited day after day and week after week to see if any official intimation would be given as to the part England was going to play in this International Exhibition, till it seemed that no more time should pass without definite information one way or the other. No official statement has been made from any quarter. No one can say for certain that England will take part in the Congress and Exhibition at all—yet months ago such official statements were made by other nations. Is it a question of impecuniosity, or have we sunk so low as to be afraid of entering the arena of science, and having our work compared with that of others? Let South Kensington speak.

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THE SOCIETY OF TELEGRAPH ENGINEERS.

At the ordinary meeting on the evening of Thursday, February 10, Professor Foster, F.R.S., in the chair, a second paper on "Earth Currents" was read by Mr. A. J. S. Adams, of the Post Office. He said that he proposed to deal in this paper with the normal earth current, as distinguished from the more variable currents that break in upon it, and which he had called "Electric Storms." After alluding to the evidence against a solar causation for normal currents, he said there could be no doubt, from observations he had made, that they were of lunar origin, as were the tides of ocean. He assumed that the moon's influence was, in proportion, felt by the earth's electricity at every part of the earth's surface. He then proceeded to state the designations by which he distinguished the different phases of the earth current.

First. An imaginary line drawn between the two maxima that always obtain upon the sides of the earth that are perpendicular to the moon is termed the *electric perpendicular*, of which the maximum *nearest* the moon is the *major*, and that *farthest* from the moon is the *minor* pole.

Second. In like manner the circle of maximum already alluded to is the *electric circle*, of which the right half, looking towards the moon, is the *ascendant*, and left half is the *descendant semicircle*.

Third. The points north and south at which these semicircles meet constitute *the poles of the lunar-diurnal electric axis*.

Fourth. The zones of no current that divide the electric-circle from the electric-poles are respectively the *major zero-circle* nearest the moon, ZA, ZD, and the *minor zero-circle* farthest from the moon, *za*, *zd*.

Fifth. The whole of the electric distribution thus arranged by the moon follows that orb in her course, and revolves about the lunar-diurnal axis; this rotation of the system is termed *lunar-diurnal circulation*.

Sixth. An imaginary line drawn round the earth at right angles to the plane of the moon's orbit, and cutting the poles of the lunar-diurnal axis, and the major and minor poles of the electric perpendicular, is the *electric meridian*, constituting a convenient basis for earth-current phase calculation.

With regard to the *apparent* direction of the normal earth-current flow, as obtained by observation, he said:—The *direction* and flow of the earth current have not, so far as I am aware, been yet satisfactorily accounted for. If the mean direction of the earth current, namely, a line running nearly N.E. and S.W., be compared with the plane of the earth's rotation, or with the solar or lunar lines of force, the greatest variance is discernible. It is, however, not a little remarkable that if we conceive the earth-current electromotive forces to revolve about the *electric-perpendicular*, as an axis, in a *contrary* direction to the earth's rotation, and take the mean of the two, we obtain a line of directive influence for the earth current agreeing with that derived by observation. This circulation of the electric distribution about the perpendicular I have termed *terrestrial circulation*, the electric-perpendicular constituting the *terrestrial axis*.

One of the most important results of these investigations is the agreement apparent between the earth-current and the *magnetic* lunar-diurnal variations. Walker,* in his essay, says: "The moon produces a *small* though sensible variation in each of the three magnetic elements—declination, inclination, and intensity.

"In the case of each of the elements we find a double progression in each lunar day.

"The declination has two easterly and two westerly maxima, and the inclination and total force have likewise two maxima and two minima in the same interval, the variation in each case passing zero four times during the lunar day."

Here we have an interesting and important fact taken in connection with the study of earth currents, the *magnetic* lunar-diurnal curves forming an exact counterpart to our lunar-diurnal current variation.

It will be obvious that if earth currents take the form of poles and circles, the electric-circle and the zero-circles would cross the earth's lines of longitude at an angle of about 18 degrees, so that the most southerly point of any line of longitude will first come under the influence of any given current phase, the more northerly points afterwards coming successively under it at a rate of progression approximately 2·4 minutes for each degree northwards. From this ratio the time at which a given lunar-current phase would reach any point west of, say, Greenwich, after leaving that place, should be deducible, and observations taken at different points upon the same line of longitude would doubtless show this to be the case; indeed, the data extant as regards the *magnetic* lunar-diurnal progression would appear to be conclusive evidence upon this point.

From curves, reduced from a table of magnetic mean lunar-diurnal variations in declination, for six stations, as computed by General Sabine,* we find that the deflections of the needle are precisely those that would presumably occur under the electrical conditions already advanced. Exactly similar magnetic lunar-diurnal variations obtain in either hemisphere, and in all latitudes, although there appears to be a decided, though regular, variation in regard to time, as compared with position upon the globe's surface. For example, upon comparing the Toronto and Pekin magnetic curves, we find that the same variation or phase appears to reach Toronto from Pekin in about eleven-and-a-half hours, and that when one westerly deflection of the needle (answering to one pole of the electric perpendicular) occurs at Toronto, another westerly deflection (answering to the other electric pole) obtains at Pekin.

Similarly we find from these magnetic curves a lapse of about eight hours between the Cape and Kew, as regards the time at which a given deflection obtains, and which, when it is recollected that this comparison is between a calculation, upon the one hand, and the mean of a number of observations extending over a period of two years, upon the other, is sufficiently near a calculated lapse of five hours for our purpose.

From this it will doubtless appear to be established that the motions of the true earth current constitute a series of tidal ebb and flow very similar to that of the waters of our globe; the chief difference being that, whereas in the case of the ocean there occur *two* flows and ebbs in each lunar day, with the earth's electricity there are *four*—a dissimilarity, however, that may yet prove to be more apparent than real.

But a comprehensive consideration of earth current phenomena opens out a much wider sphere of investigation than that simply embracing variations of strength; it has to recognise *directive influence* which, applied to electricity, means the production of magnetism. He then proceeded to say:—

"Permit me, then, briefly to point out the electric circulating systems that appear to obtain by reason of these three motions, the *earth's diurnal rotation*, the *lunar current circulation*, and the *terrestrial current circulation*—causes which result in the apparently disconnected variations observable in the movements of the magnetic needle.

And, first, we have the earth revolving about her axis, and carrying with her her latent, *i.e.*, undisturbed, electricity, at a rate of some 1,400 miles per hour. Now, it is reasonable to conclude that such motion developes a strong magnetic effect at the earth's axial poles, the precise polarity of which is easily deducible from the known law relating to electric spirals.

In the second place, we have the earth's disturbed electricity streaming round the lunar-diurnal electric axis with the moon, and completing a revolution once in each lunar month. Here, again, it is obvious that further magnetic effects are produced at the poles of the lunar-diurnal current axis, the polarity of which will be contrary to that of the axial.

Thirdly, we have the apparent circulation of the earth's electricity about the electric perpendicular, and a consequent development of magnetism at the electric poles, the polarity of which is similar to the axial as regards position.

Fourthly, the respective planes of the earth's motion, and of the terrestrial current circulation differ to the extent of about 70 degrees, and hence there would be a magnetic development at right angles to a plane which would be the mean of the two.

Thus it appears that there are at least four pairs of magnetic poles at the surface of our globe, resulting from earth-current circulation, each and all in degree exerting an influence upon the magnetic needle."

The President then called on

Professor W. G. Adams, F.R.S., who said: I read with great pleasure the author's first paper on "Earth Currents," which was communicated to the society some three years ago, and he has followed it up by a paper which we have just heard, and which raises points of very great interest and importance. Mr. Adams has said our knowledge on the subject is very meagre, but he seems to have thoroughly discussed such evidence as we possess, and, therefore, may presumably be assumed to be correct in his conclusions as to the main facts, which seem to show that there are regular diurnal earth currents to and fro over its surface, and that the general direction of these regular currents in England is from about S.W. to N.E., and that they are dependent upon something which is directly governed by the motion of the moon. These earth currents are those regular daily currents of small amount which ebb and flow like tides, and the author attributes them to lunar action through the agency of positive and negative electric charges on the earth, the distribution of those charges following the moon in her relative motion with regard to places

* "Terrestrial and Cosmical Magnetism," by Edward Walker. Deighton, Bell, and Cay, Cambridge.

* "St. Helena Observations," Vol. II.

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THE PARIS CONGRESS AND EXHIBITION.

We understand from good authority that the arrangements, so far as Great Britain is concerned, in connection with the forthcoming Electrical Congress and Exhibition in Paris have been delegated to the officials at South Kensington. This selection is peculiarly unfortunate, because the greater number of British scientific men, amateur and professional, seem to have a very decided opinion as to the feebleness of the South Kensington machinery.

We may well ask what is the position of South Kensington in regard to electrical science. Its claims to recognition, so far as we can see, are of no striking character. It nominally pays by results for the giving of elementary lessons to artizans; but in reality a large part of this payment finds its way into such places as Manchester Grammar School, and till recently to the St. Margaret's Science School at Westminster. South Kensington also trains "teachers" by giving them a course of about "four weeks" lectures, after which these scions of the school are understood to be quite capable of "teaching science." It is a delusion to suppose for a moment that South Kensington in any shape or form represents the science of Great Britain, and we take the earliest opportunity to repudiate any suggestion that it represents the special branch of science in which we are so deeply interested. Granting that South Kensington is an educational establishment, granting that its syllabus is in strict accordance with modern requirements, granting that its work is carried on in the best conceivable manner—what then? We simply come to this, that its work is in connection with elementary education, and it does not and cannot take cognisance of scientific progress. True, South Kensington has had some experience in exhibition work—but its successes in this direction are so doubtful that except in the spending of large sums of money, they may be termed imaginary.

Our opinion is that Great Britain should be worthily represented, and every effort made to show that neither in the pure science nor in the applied science are we one jot behind the whole world combined. We have instruments of precision, based upon laws determined by our *savants*, that will bear the strictest scrutiny. We have men among us whose lives are spent in original research and investigation, and who have materials at hand to embody in papers that will not be surpassed by the scientific brotherhood of other lands. As M. du Moncel so admirably argued recently in the pages of *La Lumière Electrique*, electrical science is cosmopolitan. We do not arrogate to ourselves superiority. We insist upon equality, and in this Conference of nations there should be a determined effort made to be represented by nothing short of the "best."

It seems to us that a committee composed of members nominated by the Royal Society, the Physical Society, the Society of Telegraph Engineers, and the Postal Telegraph Department would at once harmonise the scientific and practical, and commend itself to all as really and truly representative. The authorities at South Kensington may see how wrong it is of us to animadvert upon their taciturnity, by nominating a committee comprising the Presidents of the Societies named and the Chief Electrician of the Postal Telegraph Department, with power to add to their number. Whatever is done should be done quickly. The men who can represent Great Britain will not wait the convenience of South Kensington before making their autumn arrangements, and the laggard authorities may find to their how easy it is for the best laid schemes to "gang aft a-gley." The scientific press may as usual obtain its information from stray scraps let fall to the political papers, but it is doubtful if any systematic method will be adopted whereby the public can be kept fully conversant with the detailed arrangements as they are made. And yet this is what ought to be done. It is understood that almost every paper of repute has facilities for obtaining information. We maintain that together with our contemporaries *The Engineer*, *Engineering*, *Nature*, and the *Telegraphic Journal*, we should be furnished with official information on a subject which is necessarily be very interesting to our readers.

Our position is quite clear. We were many days ago informed that the communications made from France to the Postal Telegraph Department in London had by some means been transferred to South Kensington. The information may of course prove to be incorrect, but we have waited from day to day and week after week to see if any official statement would be given as to the part England was going to take in this International Exhibition. It seemed that nothing should pass without definite [illegible] any question. No official statement has been made, and no one can say for certain that the Congress and Exhibition will be held. Rumour statements were [illegible] impecuniosity [illegible] entering the [illegible] with that [illegible]

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on the earth's surface. I should have been glad to have seen in the paper more of the evidences on which the author's conclusions are based; but, assuming the relations between these earth currents and the diurnal motions of the moon, I think we must hesitate to accept the theory of electric charges and electric distribution, for this theory will hardly account for the results. Professor Rowland has shown that a statical charge of electricity, when it is carried from one place to another, will produce magnetic effects just in the same way as a current of electricity would do, and, therefore, the motion of a static charge will produce a current of electricity in its neighbourhood; but Professor Rowland has also clearly shown that the theory which would account for the earth's magnetism, and for the changes in the earth's magnetic force by supposing the earth to have a charge of electricity upon it is utterly insufficient to produce the observed effects.* From my own study of magnetic disturbances and their intimate connection with auroras and earth currents, I should be rather inclined to look to the regular diurnal changes in the earth's magnetism as the cause of these regular diurnal earth currents.

When we get magnetic disturbances in England we find that they are felt at the same instant of time at Lisbon, at Vienna, and at St. Petersburg, and even at Melbourne, and that accompanying them are auroras and earth currents, which occur simultaneously in England, and as far away as Siberia. I hold in my hand a letter just received from Dr. Wild, of the Observatory of St. Petersburg, in which he writes that, on the nights of Jan. 31 to Feb. 1, the very brilliant aurora, so well seen in many parts of England, was also seen at St. Petersburg and in Siberia. Both at Kew and at St. Petersburg it was accompanied by very violent magnetic disturbances, and we hope to hear from Mr. Preece in this discussion something about the earth currents which accompanied that storm.

This intimate relation between magnetic changes, auroras, and earth current disturbances, rather lead me to consider the regular diurnal earth current of which the author speaks, as brought about by more gradual magnetic changes in the earth.

Professor Maxwell has shown us that, with the earth revolving on its axis from W. to E., if an insulated wire were fixed in space outside the earth in such a way as to make contact with the earth at the pole and at the equator, then the revolution of the earth on its axis would cause a current in the fixed wire from the pole to the equator. If the insulated wire moved over the surface of the earth from W. to E., and the earth did not revolve, or revolved at a slower rate, then the current in the wire would be from the equator to the Pole.

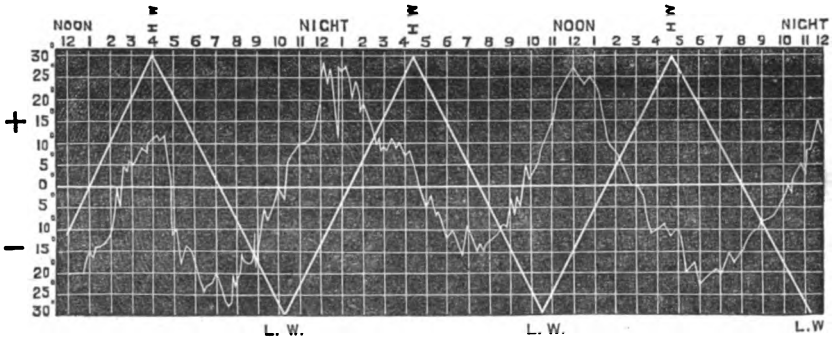
The current depends upon the relative motion of the earth and wire. Now the attraction of the moon for the earth not only causes tides in the ocean, but must also cause tides in the earth's solid crust, which is made up of materials which have a considerable degree of elasticity, and must therefore yield and alter their form to a considerable amount under the action of the moon. We thus have a lagging behind of magnetic matter, or an alteration of form, giving a relative motion of magnetic matter with regard to the wire, whilst the insulated wires on the earth's surface are carried on from W. to E.; and hence we may expect in those wires a current of electricity whose general direction would be from the Equator to the Pole.

The position of England with regard to the Magnetic Pole would modify the direction of these earth currents, and it is quite conceivable that these tides on the earth, which are directly due to the moon's attraction, may be the cause of the regular diurnal earth currents, and may account for their general direction being from S.W. to N.E. The lagging of these earth currents behind the position of the moon would also be accounted for by the lagging of the tides.

The President then called upon Mr. H. C. SAUNDERS, who said: I have listened with very great interest to Mr. Adams's paper, and also to Professor Adams's remarks. The subject of Earth Currents has been one that has occupied my attention off and on since 1858, and from my connection with the Eastern Telegraph Company I have had opportunities of accumulating a mass of data much greater than anyone else can possess. In a diagram (handed in to the President) of observations taken on the Eastern Telegraph Company's cable, between Suez and Aden, every 15 minutes, in January, 1871, there is a remarkable coincidence in the general contour of curves, between noon and midnight, and midnight and noon. The earth current, as a rule, is at zero at midnight, at 6:0 a.m., noon, and 6:0 p.m., and that is followed out very much by the idea expressed by the curves in Mr. Adams's diagram. In 1858, acting under instructions from Mr. Whitehouse, who was then the electrician of the Atlantic Company, I went to Valentia, and observed the earth currents on 300 miles of the cable lost in the previous year. I look upon these observations as the first of earth currents ever curved from observations made on a cable, certainly of any length. I also plotted the tidal curves, and seem to have had the idea that the maximum and minimum of the earth currents agreed in some measure with the high and low water mark. (See figure below.)

I did not satisfy myself as to the age of the moon, but merely put in pegs, so that I could know when the water was at high and low tide, and I plotted the mark shown in the diagram for 36 hours to indicate high and low water mark. For the rest of the time the coincidence of the curves was not so strongly marked, but still, throughout the observations, the coincidence is very clear.

At Suez I got observations from December, 1870, to March,



1871. These observations are plotted, and I should be very happy to present them to the Society to aid in elucidating the question under discussion. At the *soirée* in Willis's Rooms in 1876 I exhibited diagrams of observations at Suez and Aden for six consecutive days. They were taken very carefully, but the remarkable thing was that, after reducing the observations at Suez and Aden to the same time, the coincidence of variations were absolutely correct. When Suez became the maximum Aden became the minimum. In calculating the strength of the earth currents I have always assumed that the current, whether positive or negative, emanated from the distant end of the cable, and in all my calculations have included the copper resistance of the cable in the circuit, and so have given the force in Daniell cells at the observing end through resistance equal to that of the cable. Perhaps it would have been more correct to have given the potential at the end of the cable, but for purposes of comparison this does not matter.

It is sometimes remarked that there is a very high potential at one end of the line and very little at the other. If Mr. Latimer Clark were here to-night he would recollect that once, when testing one of the Atlantic cables, there was a potential of about 100 cells in Newfoundland and little or no earth current in Valentia. That was a very remarkable fact, and not at all usual, I think.

Mr. WOLLASTON speaking, referred to his experiences during the earliest days of cable work, and to experiments made on the Dover-Calais cable. The results of these experiments were tabulated, and were so remarkable that Mr. Wollaston was troubled to find an explanation of them. He failed. But one day, thinking about them during a long railway journey, a thought flashed across him that the results were in some way or other connected with the tides. On getting to the London terminus he drove straight to Albemarle-street and laid his ideas before the late Professor Faraday. The Professor, after hearing what was said, quietly rose, and proceeding to his bookshelf, reached down a volume, and turned to a page in which the action of the tide upon a current going through a wire carried over the water

* Professors Ayrton and Perry's supposition as to the electric charge on the earth would only account for $\frac{1}{640,000,000}$th part of the terrestrial magnetism of the earth.

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was discussed. The action was similar to that obtaining in the wire under the water, and Mr. Wollaston was satisfied as to the correctness of Faraday's theory. Turning to Mr. Adams, the speaker asked if there was not a length of cable in the line upon which the observations had been made. The answer was, a short piece across the Severn. There is the explanation. The cable supplies it, and

The President called on Professor AYRTON, who remarked that he was suffering from a severe cold, but Prof. Perry, his colleague in the investigations upon earth currents, would explain their work and conclusions.—Professor PERRY said that as Professor Ayrton and himself were responsible to the scientific world for the theory of electric tides, they were glad to see that exact and continuous records were being kept of earth currents in telegraph lines. Mr. Adams was not quite clear in his theorising. As electricity does not possess inertia of a material kind, it was not right to say that the electric tide on the side opposite to the moon is the same as the tide nearest the moon. In fact, if the density nearest the moon is greatest, the density on the side farthest from the moon must be least. He proceeded to point out what Professor Ayrton and himself had said at the Physical Society last year, namely, that although Professor Rowland has shown that a rotating uniform charge on the earth produces the most insignificant magnetic effects, yet a non-rotating uniformly-distributed charge (due to induction from heavenly bodies) may produce magnetic alterations and the phenomena of earth currents as we find them in practice.

We hope to give the mathematical investigation of Professors Ayrton and Perry in our next issue.

The discussion was adjourned to the next meeting of the Society, which will be held on Thursday, 24th inst.

PHYSICAL SOCIETY.—FEB. 12.

Professor W. G. ADAMS in the Chair.

This being the annual general meeting, the yearly report was read by the chairman. The report showed that the society now numbered 321 members as against 298 of last year. Two eminent members, Sir T. H. Elliot and the Rev. Arthur Rigg, had been lost by death. The society had decided to republish the scientific papers of Dr. Joule in a collected form. Dr. Atkinson, treasurer, read the balance-sheet for the past year, which showed the society to be flourishing. The new council and officers were then elected, Sir W. Thomson retaining the presidency. Mr. Bakewell and Herr G. Wiedemann were created honorary members. Votes of thanks were passed to the Lords Commissioners of the Council of Education for granting the use of the meeting room to the society, to Professor Adams, to Dr. Guthrie (the Demonstrator), the Auditors, and the Secretaries (Professors Rheinold and Roberts). The meeting was then resolved into a special general meeting, and a resolution put and carried, giving the council power to invest money of the society in the name of the society or of persons appointed by them in certain stock, home and foreign. The meeting was then constituted an ordinary one, and Mr. T. WRIGHTSON, C.E., read a paper by Professor Chandler Roberts and himself on "The Density of Fluid Bismuth." By means of the oncosimeter, an instrument which records on a band of paper the sinking or floating effects of a ball of the solid metal immersed in the molten metal, they had determined the density of fluid bismuth from six experiments to be 10·055. A former value by a different method was 10·039. In the discussion which ensued Mr. Wrightson stated that his experiments proved solid cast iron to be heavier than fluid, and to sink in the latter when first immersed, but it rapidly became lighter as its temperature rose till it floated when in its plastic state, and was consequently lighter than when in the molten state. The oncosimeter could be utilised for determining the change of volume in melting rocks; and Professor Chandler Roberts suggested that it might throw light on the difference of state between the carbon of grey pig and white iron.

Dr. O. J. LODGE exhibited working models showing the hydrostatic analogy between water and electricity. A battery was represented by a pump, conductors by open pipes, dielectrics by a pipe closed by an elastic membrane, electromoters by pressure gauges. With these analogies he showed the action of a Leyden jar, and the passages of telegraphic signals along a cable.

TELEGRAPHIC COMMUNICATION BETWEEN LIGHTHOUSES AND SHORE.—A petition was adopted on Monday last in favour of the above for our coasts at a meeting at Ramsgate.

CORRESPONDENCE.

A NEW VOLTAIC CONDENSER.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Your issue of September 11, 1880, p. 194 contains the description of a "New Voltaic Condenser." I tried the secondary battery with a cell holding 3lbs. of shot and a carbon exposing about 4½ square inches of surface and saturated solution of sulphate of zinc. I connected it with two Bunsens, passing the current from carbon to zinc as directed. After about half an hour I disconnected and tried the secondary battery on the galvanometer, and it moved it in the reverse way to what the exciting cell would. The existence of a reverse current proved that there had been some action, but it was exceedingly slight. It moved a delicate galvanometer about 40 degrees, keeping it there for nine minutes, and then falling slowly. It would do nothing else. I must therefore conclude that the action is very limited, or there is something wanting in the description. I should feel obliged if, through the medium of *The Electrician*, you or some of your readers would throw some light on the subject.—Yours, &c., G. K.

Hull, Feb. 14th, 1881.

LITERATURE.

Telegraphic Tales and Telegraphic History. By W. J. JOHNSTON, Editor of the *Operator*. [New York: W. J. Johnston, publisher, Murray-street.]

This is a neat little book, with an awkward title, and a somewhat *scrappy* form of composition. The author's laudable purpose is to give a popular account of the "uses, extent, and outgrowths" of the electric telegraph, and we think he would have carried out this design at least as well if he had not spiced his work with a great many "funny" anecdotes, which, in fact, make up about half of it. "With the American propensity to relieve overtaxed energies with harmless nonsense everybody is familiar," he says; but we stolid Britons are sometimes inclined to wonder at the ease with which our cousins allow themselves to be amused. On the other side of the Atlantic, where electricity has produced so many new features of life, from telegraphic swindles to marriages by telegraph, there has already sprung up a good crop of what our author calls "humours of the telegraph." Of this new class of stories he gives us specimens more than enough, which may commend themselves to younger readers whose taste is still in the Joe Miller stage. We like better that part of the book dealing with facts; many incidents and experiences of American telegraphic life come fresh to us; the concise compilation of telegraphic history seems carefully done; everything is there which ought to be there, not excepting the quotation about putting a girdle round the earth in forty minutes. On the whole, Mr. Johnston may be congratulated on having given us an interesting little volume, which we have read with pleasure, only skipping some of the "spice" above alluded to. We presume it is too late to ask Brother Jonathan to consider his literary ways, else we would mildly hint that such phrases as "Mr. Kettles *concedes* that he copied the message," and "*Right here* we must *shut down* on funny stories," affect us disagreeably as with an electric shock. We salute respectfully America's Edison—would that she paid a little more reverence to our Addison! If this joke seems trivial, it is the example of the book that has infected us.

THE MICROPHONE IN ASTRONOMY.

For some time past the microphone of Professor Hughes has been in use at the Observatory of Geneva for transmitting the beats of an astronomical pendulum from one place to another in such a manner that different observations made in different rooms of the Observatory can be timed by the same pendulum. A description of the arrangement adopted was recently given by Dr. Wilhelm Meyer, before the Society of Physics and Natural History of Geneva, and may be useful to English astronomers.

Before proceeding with his account of the special application

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in question Dr. Meyer offered some remarks on the construction and operation of the microphone itself. The form adopted is the original one, which consists of two brackets of retort carbon fixed to a dry board one above the other, and supporting a vertical pencil of carbon loosely inserted into two cuplike holes, or sockets, hollowed out of the inner surfaces of the brackets. The microphone of the Observatory line is fixed to the exterior of the standard Arnold pendulum. One pole of a middling-sized Medinger cell is connected to the microphone, whilst the other pole is connected to the microphone through a telephone and a commutator with three studs. The two wires connecting the telephone are twisted into a long strand, so as to lead into different rooms, in order that the beats of the clocks there can be directly compared with the beats of the standard pendulum. The telephone is of large size, and made by M. Hipp of Neuchâtel. It can also be transported into the western cupola of the Observatory, where the alt-zimuth instrument is placed.

In default of a good astronomical pendulum it was formerly the custom to have recourse to chronographic registration for observing the passage of stars. Now these passages can be observed by ear, in listening to the beats of the Arnold pendulum in the telephone. A simple counter of seconds, or pocket chronometer, serves to determine at each new observation the number of the second, and the exactness of the observations made in this way is not inferior to that obtained without the intermediary of the microphone and telephone.

The same microphone and battery serve to transmit the beats of the second Arnold to the tower of the grand equatorial, but this is done by means of a second telephone, No. 2, installed in the tower, which has one wire fixed to the third stud of the commutator. By the latter the microphonic current can either be shunted to the telephone in the tower or that in the cupola. Or the current can be sent through both telephones at once, in which case the beats of the Arnold pendulum are heard simultaneously in the cupola and tower, without perceptible diminution of the sounds. In fact, branch circuits can be multiplied as desired in the Observatory without sensible loss of power, and hence the value of the method. For all observations made by ear a single pendulum will suffice in an astronomical establishment, however extended it may be, and the arrangement is most adapted to an equatorial of great dimensions. The position of a star sometimes obliges the observer with this instrument to shift his ear to a point almost out of earshot of the pendulum beat itself, but the reproduction of it in a telephone can, of course, be be brought as near to him as possible; in fact, the telephone can be attached to the ear itself.

A microphone line between the Observatory and the Hotel Municipal at Geneva has operated since April, 1880, and serves to regulate the pendulum which transmits the hour to the electric clocks. In this circuit the earth is employed as a return wire; the microphone is placed interiorly at the bottom of the cage of the regulator at the Hotel Municipal; one of the wires from this microphone goes to one of the poles of the battery, of which the other pole is "to earth." The other wire of the microphone goes by an aerial line to the Observatory, where it is fixed to one of the studs of a second commutator, by aid of which the circuit can be closed after having made the current pass by the bobbins of telephone No. I.

By this means one can hear in telephone No. 1 of the Observatory the beats of the regulator of the Hotel Municipal, the electric circuit between the two establishments being completed by the earth. Moreover, another stud of the commutator allows an electric bell to ring, or an ordinary telegraph between the two stations to come into action.

By this arrangement the astronomical hour is transmitted to the hotel as follows:—The astronomer charged with the service of the pendulums hears in telephone No. 1 the beats of the municipal regulator. He can easily determine the number of the second of that regulator, because at each full minute, or sixtieth second, the regulator sets going the auxiliary movement which establishes the electric contacts for the different lines of the clocks, and the starting of this movement is plainly heard at the Observatory. By means of the microphone line a comparison of the hotel regulator can then be made with the standard pendulum at the Observatory, and the error of the regulator can thus be found with as much exactness as that of a pendulum in the Observatory itself. At a convenient hour the person charged with the service of the electric clocks warns the astronomer that he is at his post. He then connects up the telephone line, and the astronomer acquaints him with the error of the regulator, which he then regulates by help of auxiliary pendulums. After that operation he re-establishes the microphone line so that the astronomer can make a second comparison, and the result is telephoned as before. This occupies only about five or seven minutes, and the apparatus has continued to work well since its installation.

Dr. Meyer finds by experiment that the microphonic beats can still be distinctly heard in the telephones, though the current is passed through a rheostat of 6,000 Siemens units, and a solution or ordinary salt of an equal resistance, making a total resistance of 1,200 kilometres of telegraph wire. And, curiously enough, the current passed and the beats were heard, though one of the wires was not dipped in the solution, and the current thereby had to traverse three millimetres of cork.

With the microphone arrangement above described it has been successfully demonstrated that two distant pendulums can be regulated by ear as well as if they were near together, the error of a comparison made between a sideral pendulum, and one of mean time does not surpass three hundredths of a second. Actually the comparison of the local hour of two distant places, or in other words, the determination of the difference of geographical longitude between two astronomical stations is made by means of the telegraph and chronograph; but by employing a microphone line a number of the errors of this method could be eliminated, particularly certain defects in the working of the chronographs and other apparatus, which do not exist in the case of the microphone. Thus, for example, the time which lapses during the arrival of a current, and in the magnetising of the relay or the chronograph is not constant, whereas in the microphonic it is only a question of a very feeble variation of the magnetic state of the telephone in circuit. The microphone communication permits the observer to time the passage of the same star in two widely-sundered stations by the same pendulum; and the correction of the pendulum, determined at the same time by two observers, makes known the difference of longitude. The personal equation between the two observers can be eliminated by changing the places of the observers, and making a second series of observations. In this manner the errors of the chronograph, by exchanging signals for the comparison of pendulums, will be eliminated, and the uncertainty of the pendulum beats will be reduced to a minimum if the difference of longitude is not considerable.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Feb. 16.		Business Done Week Ending Feb. 16. Highest.	Lowest.
Anglo-American	59¼,	½	60½	59¾
Do. Preferred	87½,	88	88¼	87½
Do. Deferred	31½,	¾	32¼	31½
Brazil Submarine	9 15-16,	10 1-16	10	10
Cuba	8¾,	9	—	—
Do. Preference	16,	¼	16½	16¼
Direct Spanish	3,	¼	3½	3¼
Do. Preference	13,	¼	13½	13
Direct United States Cable	10¾,	11¼	11¼	11
Eastern Telegraph	9 9-16,	11-16	9¾	9½
Do. 6 per Cent. Preference	12¼,	½	12¼	12¼
Do. 5 per Cent. Debentures, 1899	101,	104	—	—
Eastern Extension	10 1-16,	3-16	10¼	10
German Union	9¾,	10¼	10¼	9⅝
Globe Telegraph and Trust Company	6 7-16,	9-16	6 9-16	6 7-16
Do. Preference	12 1-16,	3-16	12½	12
Great Northern	10¾,	11¼	11¼	10¾
Indo-European	26½,	27½	—	—
Mediterranean Extension	2¾,	3¼	3	2¼
Do. Preference	10¾,	11¼	11	10¾
Reuter's	10¾,	11¼	—	—
Submarine	270,	275	—	—
West India and Panama	1 9-16,	11-16	1 11-16	1½
Do. 1st Preference	6½	¾	6¾	6¾
Western Brazilian	7 13-16,	15-16	8	7¾
West. Union 7 per Cent. 1st Mortgage	122,	127	—	—
Do. 6 per Cent. Sterling Bonds	104,	107	—	—

TRAFFIC RECEIPTS FOR JANUARY, 1881.

Companies.	Jan., 1881.	Jan., 1880.	Increase.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,800 estd.	3,406	—	606
Direct Spanish Telegraph Company	1,506	—	—	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	49,445	48,887	558	—
Eastern Extension Telegraph Company	29,434	28,009	1,425	—
Great Northern Telegraph Company	17,360	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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ABSTRACTS OF SPECIFICATIONS.

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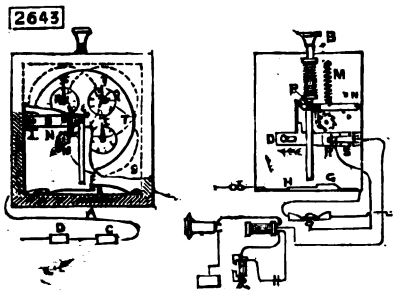
2643. IMPROVEMENTS IN REGISTERING APPARATUS FOR USE IN TELEPHONE SYSTEMS OR EXCHANGES, *J. H. Johnson.—Dated 28th June*, 1880.—(*A communication from C. J. Bell and S. Tainter.*) 8*d*.

This is an invention for registering the number of times the telephones of a system or exchange have been used; if, however, the central office be called and no answer received the apparatus does not register the telephone as used. With the call arrangement and registering apparatus a switch is combined, so that the first operation of the call arrangement to send a signal causes the operation of the registering device, but any subsequent operation of the call arrangement till the answer



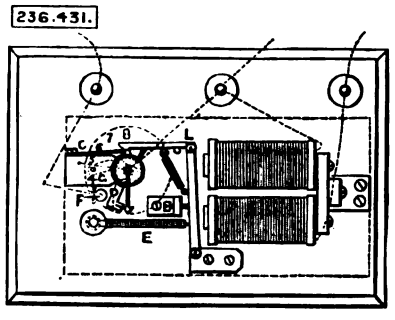
is made to repeat the signal fails to further affect the apparatus. A subscriber cannot call the central office except by means of the proper push knob. In first figure, A shows registering device, B the push knob, C the call bell, and D the transmitter. The registering apparatus consists of dials showing units, tens, hundreds, &c. In the second figure, A is the portion of the call register more particularly concerned in this invention, E being a secresy switch insuring privacy of communication. There are thirteen claims to new combinations.

2826. IMPROVEMENTS IN TELEPHONES. *John Imray.—A communication from Dr. C. Herz, Paris. Dated 9th July*, 1880.—(*Not proceeded with.*) 2*d*.

The object of this invention is to obtain great distinctness in the sounds, even when they are transmitted over considerable distances. For this purpose the receiving instrument is rendered microphonic by the employment of discs or blades of conducting ores, such as sulphides of iron, copper, lead, and other analogous compounds, each of those discs or blades being separately connected to pairs of voltaic elements, and all being pressed together with adjustable pressure and subjected to the sound vibrations of a diaphragm. By the use of discs thus connected and arranged the sounds are magnified, and in order to render them clear and distinct when transmitted, condensers are introduced in the line conducting from the one station to the other. A condenser may for this purpose be applied near either station, or it may be introduced into any part of the line, or several condensers may be introduced along the line. The microphonic appliance above referred to can be variously modified. For example, between the discs or blades conducting powers, such as pulverised graphite, bronze, and other powders, may be introduced with good effect. The battery to which this appliance is connected is most advantageously arranged with its elements connected for tension, the junctions of the elements being connected by branch wires to the microphonic discs or blades, and the terminal wires being connected respectively to the receiving diaphragm and to one of the plates of the condenser from which the line wire is led. Instead of voltaic cells, dynamo-electric or magneto-electric machines may be employed, their several coils being connected in a manner similar to the connections of the voltaic cells as above stated. Independently of the use of microphonic appliances such as those described, the introduction of condensers in the line is of value for producing distinctness of transmission, whatever be the telephonic instrument employed. In some cases it has been proposed to employ condensers, but only when the electrical currents are of high tension, and when they are used for transmission of inarticulate sounds, such as musical tones. By the use of condensers according to this invention for ordinary telephonic lines, the distinctness of transmitted articulation is greatly improved, and in consequence of such improvement in distinctness by this means, the sounds may be magnified by any known microphonic appliances, and consequently can be transmitted over great distances.

236431. INDIVIDUAL ATTACHMENT FOR ELECTRIC BELLS, *Angus S. Hibbard, Milwaukie, Wis.—Filed September 3rd*, 1880. *(Model).*

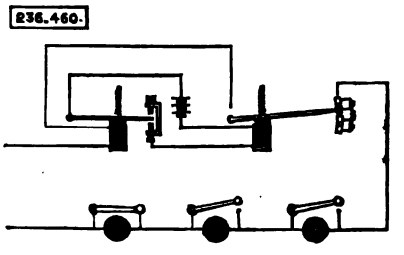
Brief.—Improvement in that class of apparatus known as "step-by-step" devices, whereby one station can be called without sounding the bell at any other station. *Claim.*—(1) The combination in an individual attachment for electric bells, of the magnet, hinged armature, pawl L, spring E, ratchet, excentric spring C, and arm D, with button F and connecting lines, as set forth.



(2) The combination, in an individual attachment for electric bells, of the magnets hinged armature, pawl L, ratchet wheel, excentric and springs, pawl G, arm D, button F, indicator, and dial, and connecting lines, as set forth. (3) The combination with the ratchet wheel and arm with the indicator having weighted end for bringing the instrument to unison after the last tooth of the ratchet has passed the pawl L, as described.

236460. AUTOMATIC REGULATOR FOR ELECTRIC CURRENTS, *William E. Sawyer and William Sawyer, New York, N.Y., assignors to Eastern Electric Manufacturing Company, Middletown, Conn.—Filed October 2nd*, 1880. *(No model).*

Claim.—(1) In an electric distributing system, the combination of a generator of electricity, a series of electric engines or other apparatus, a



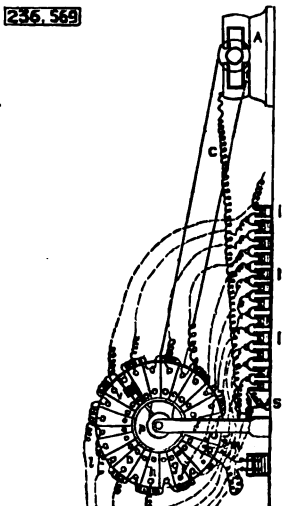
relay magnet in the local circuit provided with a current regulating armature automatically operated, and actuating mechanism to introduce or cut out resistances in the main line, substantially as described, and for the purposes set forth. (2) In an electric distributing system, the combination of a generator of electricity, a series of electric engines or other apparatus, a relay magnet in the main circuit operating a local circuit, and an electro-magnet in the local circuit provided with a current regulating armature actuating a lever traversing a series of resistance terminals in the main circuit, substantially as described.

2665. CASINGS FOR UNDERGROUND TELEGRAPH WIRES, &c., *W. R. Lake.—Dated 29th June*, 1880.—(*A communication from R. B. Lamb.*) 6*d*.

This consists of blocks of terra-cotta or other suitable material, having one or more passages or channels lined with india rubber, or equivalent material.

236569. EQUALISING DYNAMO-ELECTRIC CURRENTS BY MEANS OF SECONDARY BATTERIES, *Stephen D. Field, San Francisco, Cal.—Filed August 4th*, 1879.

Brief.—The current from a dynamo-electric machine is thrown from one cell to another throughout a connected series, whereby said series of cells are rendered capable of giving a continuous secondary current. The invention consists in peculiarities of the apparatus. *Claim.*—(1) The improvement in utilising dynamo-electric currents for telegraphic purposes, consisting of the commutator provided with alternate wide and narrow plates, the former being connected together in pairs and to a series of battery cups, and the latter plates upon each side of the commutator being connected each to the other and to separate battery cups, in combination with a dynamo-electric machine, its conducting wires, and the circuit wires, substantially as and for the



purpose set forth. (2) The combination of the commutator D, provided with alternate wide and narrow plates, *g h*, the plates *g* being connected together in pairs and to battery cups, and the plates *h* upon each side of the commutator being connected each to the other and to separate battery cups with the dynamo-electric machine A, wires B C, springs *p*, arms *n*, having hubs O, and brushes V, substantially as and for the purposes set forth. (3) A stationary commutator, D, provided with the alternate wide and narrow plates on each side, all the narrow plates on each side being united by a single wire and connected with a cup, J, while the wide plates in pairs are connected successively with the cups I I of a battery, in combination with the dynamo-electric generator A, wires B C, springs *p*, arms *n*, with their hubs O, and the brushes V, all combined and arranged to operate substantially as and for the purpose described.

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SLIP

London Institution.—Professor W. E. Ayrton's lecture, which was postponed on January 20, will be delivered on March 3rd.

Western Brazilian Telegraph Company.—Sir Henry Drummond Wolff, K.C.B., G.C.M.G., M.P., has accepted the chairmanship of this company.

Street Fire Alarm Boxes.—It is suggested that fuller and more conspicuous instructions should be issued as regards the proper mode of giving the alarm in case of fire.

Electric Light at Norwich.—The Town Council, preparatory to adopting the electric light in their streets, have given their sanction to its trial in the market place.

Electric Light at Greenock.—The Greenock Harbour trustees have arranged with Mr. Crompton for the erection of four lamps on the steamboat quay, for one month's trial.

The Herz Telephonic Systems.—We are compelled to leave for our next issue an article on this subject, by M. le Compte du Moncel, translated from *La Lumière Electrique.*

Another Electric Light Company.—The New York *Engineering News* says that the Columbus Electric Light Company, with a capital of 100,000 dollars, has been incorporated.

Telephones for Bordeaux.—The Bordeaux papers say that the local authorities are treating with M. Gauthier, of Paris, for the erection of telephone lines, both overhead and underground, at that town.

British Museum.—The First Commissioner of Works has under his consideration a proposal to open the British Museum of an evening, the introduction of electric lighting enabling him to do so with safety to the pictures.

Value of Telegraph Stock.—The *Rochester Union* (U.S.A.) says that an original investment of 10,000 dollars in Western Union Telegraph Stock is now held at 481,700 dollars, and that the cash dividends amounted to as much more.

Advantage of the Electric Light.—The contractor for a new bridge being built at Cork, in order to get his work done within the specified time, is having the electric light installed, so that he can work night and day. What would he have done a few years back?

Submarine Telegraph Company.—This company's report states that the gross earnings for the half year were £67,237, and, after adding £5,592 to the reserve fund, the directors recommend a dividend at the rate of 19 per cent. per annum, leaving £968 to be carried forward.

The Aurora.—The display which was seen all over England a few days ago, was also noticed in Germany, Belgium, Holland, France, and Russia. In the latter country it was accompanied by magnetic disturbances, which interrupted the telegraph service for several hours.

An Enterprising Native.—The Austrian papers state that an Indian prince was so struck with the accounts he read of the electric railway exhibited at the Austrian Industrial Exhibition that he has purchased it, and ordered it to be sent to India. He has also secured the services of the engineer in charge.

Government Payment for Landing Telegrams.—In the House of Commons, on Tuesday, Lord F. Cavendish informed Sir H. Tyler that 250 payments had been made by the Government to steam packet owners for landing telegrams at Natal, the Cape Colony, and St. Vincent since the outbreak of the Zulu war.

Prices.—The prices of gutta percha as quoted are, per lb., for genuine 4d. to 3s. 3d., reboiled 3d. to 1s. 3d.; india rubber, per lb., Para (fine) 3s. 4d., negrohead 2s. 3d., Central American 1s. 9d. to 2s. 4d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 2d.

Combination of Electric Light Companies.—We are informed that the companies severally working the Jablochkoff, Gramme, Jamin, and Werdermann systems are on the eve of combining in one company, with a large capital. This important step is being carried out under the auspices of one of the chief financial houses of Paris.

Postal Telegraph Clerks.—"We," *Daily Telegraph*, "understand that Mr. Fawcett intends to grant an interview to a deputation of representative clerks of both sexes from the various departments of the telegraph service in the metropolis and the provinces, in order that they may personally state their grievances to him."

Electric Signals for Railways.—The Paris-Lyon-Mediterranée Company have decided to erect new telegraph posts between stations distant more than eight or ten kilos from each other. Semaphores will be placed near these posts, and thus trains can be stopped and kept at a proper distance from another.—*La Lumière Electrique.*

Dividends.—The London Platino Brazilian Company give notice that Messrs. Glyn, Mills, and Co. will pay the half-yearly coupons, falling due on 1st March next, of £100,000 Seven per Cent. Debentures, on and after that date. The coupons must, however, be left with Messrs. Glyn three clear days before payment can be made.

The United Telephone Company.—Although this company has thought better of its threat of taking action against the Post Office for using the Gower-Bell telephone, we notice that proceedings have been taken against a firm of telegraph engineers in Glasgow for employing that form of instrument in the Douglas-street Telephone Exchange.

Chinese Telegraphy.—The *Hamburgh News* states that the Northern Telegraph Company has concluded a contract with the Chinese Government for the construction of a telegraph wire between Shanghai and Tientsin, a distance of about 1,000 English miles. Nine or 10 telegraph stations will be opened at the most important points.

Photophonic. — "Theoretically a telephone with a blackened disc [diaphragm] enclosed in a high vacuum, and connected with an external telephone should serve as a receiver; and the writer of these lines has already attempted to devise a thermo-electric receiver for reproducing sounds from invisible calorific rays."—S.P.T. in *Nature.*

Laying of New Cable.—Information has been received by the Cuba Submarine Telegraph Company of the successful laying of their new cable between Cienfuegos and Santiago de Cuba. This is the third cable which has been laid by the company between these points, but as the 1870 one has ceased to work only two are now in operation.

New Line Between New York and Chicago.—The *Engineering News* announces that a Merchants' Telegraph Company has been formed in Chicago to run a line of wires between New York and Chicago. Capital, 1,000,000 dollars. The intention is to run four or five wires, which can be put in operation for 500,000 dollars. The head office is Chicago.

A Yankee Story.—An American paper says:—"One of the electrical curiosities manufactured by Mr. Leo Daft in the course of his experiments was an electric lamp so small that it could be carried in the vest pocket, or held lighted *in one's mouth* for an hour or two without fatigue. The light

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was so brilliant that it could be seen through the solid tissues of the face, and be used to illuminate them for medical purposes."

THE ATLANTIC CABLES.—The Direct Cable Company and the French Cable Company have, it is stated, filed bills of complaint against the Atlantic and Pacific Telegraph Company, the Western Union Telegraph Company, and the American Union Telegraph Company, asking for a perpetual injunction against their consolidation. The case came on for hearing on the 24th inst.

NEW CABLE TO KIRKWALL.—A petition has been forwarded to the Postmaster-General from the principal inhabitants in Lerwick, praying that a new telegraph cable be laid direct from the mainland of Scotland to Shetland, instead of through the tideways of the Orkney Islands. The telegraph has been much interrupted of late, and it is believed the proposed route would be a much better one, and less liable to accident.

TELEGRAPH CLERKS' GRIEVANCES.—A large meeting, attended by 800 London telegraph clerks, was held at the Foresters' Hall, Clerkenwell, on Saturday last, for the purpose of embracing within the scope of the agitation the whole body of clerks employed in the Postal Telegraph service. Letters were read from several members of Parliament, including Sir Stafford Northcote, Dr. Playfair, and the Lord Mayor. The last-named dignitary has invited a deputation of the clerks to wait upon him at the Mansion House this day.

THE BRUSH LIGHT IN COLORADO.—The *Leadville Chronicle*, speaking of the Brush Light, says:—"The large Alice mills in Montana are lighted with it at a saving of 8 dollars per day over oil. The lights cost but a cent. an hour each, where the small power required is available, and each light is equal to 2,000 candles, or more than 100 gas jets. Cities and streets are being lighted with it, and in many places central lighting companies are being organised to light stores, saloons, and hotels. In Salt Lake City, 105 lights will be started in a few days. The agent has just returned from Bassickville, where he erected apparatus to light that company's works. The Bassick Company gets about twenty times as much light as formerly, at a saving of about 4 dollars per day. Theirs was the first electric light erected in Colorado."

ELECTRO GOODS AT THE MELBOURNE EXHIBITION.—Messrs. James Dixon and Sons, of Sheffield and London, have some good exhibits of electro Britannia metal, consisting of various dish covers, coffee sets, and other specimens of most elaborately-finished electro work. A massive centre-piece of oxydised silver attracts much attention from its faithful reproduction of nature. It consists of an oak tree, beneath which are grouped several farm animals, such as the horse, sheep, &c., the models being very accurate. This really splendid agricultural trophy is supported on either side by massive silver challenge cups of 120oz. and 160oz. respectively, and two magnificent plateaux and stands. A massive gilt Corinthian candelabra stands at each end, and appropriately completes a set of goods which have no equal in the Exhibition.

PRIVATE TELEGRAPHS.—Mr. Fawcett stated in the House of Commons the other evening that the Post Office authorities did not object to owners of land erecting poles or wires for telegraphic (including telephonic) purposes thereon, so long as the telegraph or telephone was used exclusively for the purposes of the owner. But owners of land would be prevented by the provisions of the general telegraphic Acts from allowing poles or wires to be erected for the purpose of carrying messages for persons other than the owners for payment, as aiding in the carrying of messages for the public is an infringement of the rights of the Post Office. It must also be understood that the owners of houses forming part of a street, or adjoining a public roadway, cannot by virtue of such ownership confer power on anyone to erect poles on or carry wires along or over such street or roadway.

THE CHARGE FOR PRESS TELEGRAMS.—A Thurso gentleman, also a newspaper correspondent, has lately written to the Postmaster-General on the above subject, asking whether a fractional charge of 3d., 6d., and 9d., could not be made for every 25, 50, and 75 words respectively, after the first 100, instead of the plan now in vogue, under which, if the message be only 105 words, it is charged 2s., as if it contained 200 words. He stated that, under the present system, messages were frequently condensed to the detriment of the contents, in order to keep within the 100 words; whereas, if the above fractional charge were made, correspodents would write in full, and, in his opinion, a considerable gain in revenue would result. The Postmaster-General replied that the tariff was fixed by the Telegraph Act (1868), and he was not prepared to take steps to amend it, though he was obliged for the suggestion.

FITZGERALD ELECTRIC LIGHT AND POWER COMPANY.—The capital of this company is £100,000, in 100,000 shares (50,000 preferred "A" and 50,000 preferred "B") of £1 each, with power to increase. First issue, 5,000 "A" shares, payable 10s. on application, and 10s. on allotment. It is formed to carry out an agreement between D. G. FitzGerald and W. Arbuthnot of the one part, and W. H. Beaumont, on behalf of the company, on the other part, to work Mr. FitzGerald's inventions, though it also has the power to acquire from other persons any inventions in electric lighting and power. The company will also have the power to manufacture a pure carbon by a process arrived at by Mr. FitzGerald, but not patented. The directors are Messrs. W. Arbuthnot, T. P. Powell, and E. T. Roberts, with power to add; Prof. Adams, F.R.S., is the consulting electrician, and Major W. H. Beaumont, the secretary.

THE TELEPHONE AT HOME.—An interesting account of the extreme utility of the telephone in a private house is given by M. de Weber, a German gentleman, who has lately visited the States. Upon his arrival at the house his hostess, by means of her telephone, informed her husband of her guest's arrival, ordered her carriage from the stables, gave orders for her yacht to be got in readiness for a trip, put them on the *qui vive* at her country house, invited some friends to dinner, and sent an order to her dressmaker; her cook next monopolised the instrument, and ordered the necessaries for dinner, &c. M. de Weber, who has evidently a turn for mathematics, estimated roughly that what it had taken mistress and servant forty minutes to accomplish would have taken several persons forty hours and more. In towns in the Western States he says that a third of the houses are connected telephonically, the tax for this being fifty dollars per annum, no matter what may be the length of the wires, this sum covering all the expenses of installation, reparation, &c.

ACCIDENTS BY LIGHTNING.—Herr Holtz has lately been interesting himself in the question of the increase or decrease in the number of thunderstorms occurring year by year, and the accompanying accidents by lightning. He has published two tables, one to show the increase or decrease of thunderstorms since 1854, since 1862, and since 1870 in different regions of Germany, Austria, and Switzerland; the other the increase or decrease of lightning risk estimated from com-

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parison of the number of lightning strokes on houses, with the entire number of houses. From these it would appear that while any increase in the number of thunderstorms is extremely small, and there is in some cases even a decrease, the lightning risk shows a very large increase, and in no case a decrease. Thus, the increase of risk from lightning must be regarded as not due, unless in a very slight measure, to meteorological influences. This appears more distinctly in that the increase of lightning risk is proportionately greater as the compared years are further apart; but it is not so with the increase of thunderstorms, which *e.g.*, is less since 1854 than 1862. To explain the increased risk by telluric changes, Herr Holtz supposes the clearance of forest land has to do with it, perhaps, also, the increase of railways, both of these bringing thunderstorms more to towns and villages. Another probable cause is the increased use of metal in house construction.

Smelting Iron and other Ores.—A correspondent, referring to Dr. Siemens's address at Glasgow, sends us a copy of a patent provisionally protected in 1853 by John Henry Johnson. Our correspondent refers to the invention as an anticipation of Dr. Siemens's furnace. The following is Mr. Johnson's own description:—This invention consists in the smelting of metallic ores, particularly iron ore, which have been previously mixed with charcoal by the application of the electric light to that purpose. This is effected by dropping the ore or metal to be melted between the poles of two large electrodes, which are connected in the ordinary manner with a galvanic battery. The electric light thus produced melts the ore as it passes through it, and the melted metal with the slag falls into a receiver below, where it is kept in a state of fusion by a suitable furnace placed beneath it, the different specific gravities of the "slag" and melted metal keeping them separate in the receiver. By another arrangement the two electrodes are placed at a slight angle and the higher one of the two is made hollow and filled with the ore to be reduced. This ore is gradually pushed forward as it melts by a piston and screw rod working within the hollow of the electrode. When the whole has been reduced the piston is withdrawn and the electrode filled again. As the electrodes are consumed, they are caused to advance by screw spindles working in fixed nuts, and attached to armatures or sockets on the ends of the electrodes, or by the apparatus a continuous supply of electrodes may be attained in various other ways.

Electric Light in Hull.—The engineer's report on the two tenders sent in by Messrs. Siemens and the Brush Light Company was received last week by the Corporation. The tenders were invited in two forms. 1st. For supplying permanent plant and apparatus, and for working the same twelve months; and, 2nd, for supplying illuminating power for twelve months, the Corporation having the option of purchasing the plant and apparatus at the expiration of that time for a specified sum. Under the first form, Messrs. Siemens Brothers and Co. (Limited), and also the Anglo-American Brush Electric Light Corporation (Limited), both tendered; but one tender only was received under the second form, and that was from the first-named firm. Messrs. Siemens Brothers's tender under the first form, for supplying apparatus and plant for supplying street lighting for fourteen lights of a total of 41,000 candle-power, and for six lights for the Town Hall, of a total of 8,800 candle-power, with machine power in addition for four lights of 400 candle-power, amounted to £4,750. The tender for working expenses for the year was £1,006. The tender of the Brush Company, for plant and apparatus, for streets and town hall, lighting for twenty-seven lights of 2,000 candle-power (54,000 candle-power), with machine power in addition for five lights of 2,200 candle-power, was £2,425. The tender for working expenses for the first year was £583. Messrs. Siemens Brothers's tender, under Form No. 2, for supplying illuminating power equal to 49,000 candle-power for 4,000 hours during twelve months, was £1,750; the cost of plant, in good condition, at the expiration of twelve months, should they desire to purchase, would be £4,500. After some discussion, during which it was proposed to accept the Brush Company's tender, an amendment was carried that the engineer and chairman be deputed to come to London to watch the trial of the two lights, and report further.

Electricity as a Source of Power and Light.—Under this title a lecture was delivered recently at the Cleveland Institute of Engineers, Middlesbro', by Mr. J. N. Shoolbred. The transmission of power was illustrated by a saw-bench driven by a Siemens machine, which received its power from another Siemens machine. There was also a small printing press actuated in a similar way, the primary power being supplied by a steam engine lent by the Middlesbrough Corporation. It was pointed out that the operation of smelting ore in the Siemens furnace was performed in about a quarter of the time employed in other methods. One pound weight of broken files was melted in thirteen minutes. It was shown that as to the efficiency of the furnace its power was on a par with that of the regenerator gas furnace in melting steel. For instance, to melt a ton of steel a crucible required $2\frac{1}{2}$ to 3 tons of Durham coke; the regenerator gas furnace required one ton of coal, and the open-hearth furnace required 12cwt. of the same. The lecturer then explained the Swan incandescent and the arc lights, stating that the difference between the two was such that the latter produced an equivalent to 150 candles per horse-power, and the former from 1,000 to 1,200 candles light per horse-power. At the termination of the address there was an interesting discussion. Mr. Harrison, agent for Mr. Siemens at Newcastle, referred to the Siemens lights used at Bolckow, Vaughan, and Co.'s Works, Eston. He said there were twelve at work, which cost sixpence per light per hour, including men's time, coal, oil, and waste. Mr. Head, ironmaster, described his experience of Swan's light, as seen at Sir William Armstrong's residence at Rothbury, Northumberland. There were 40 electric lamps, but 37 of them were generally used at a time. Each lamp was in power equal to 37 candles, and he could light all the lamps in two or three rooms, or throw the power all into one room. In the large library, reading at night by a single lamp was a simple matter, and the pictures just looked as in daytime.

Electricity and Pain.—Many people have observed that a blow or other jarring shock will sometimes dispel pain; but the importance of mechanical vibrations as an anodyne is now engaging the serious attention of physicians. For some years past Dr. Mortimer Granville has been endeavouring to find a good means of mitigating the pangs of neuralgia by a recurring series of shocks administered to the skin over the affected part, and he has constructed an apparatus for the purpose which has been employed successfully on various occasions. M. Boudet, of Paris, has, however, quite recently developed the subject still further, and applied the ordinary diapason, or tuning fork, to the purpose in question. He was led to do this by the experiments of M. Vigouroux, who provoked contractions in hysterical patients, and subdued the pains of a nervous cripple by causing the sonorous waves from a vibrating tuning fork and sounding board to impinge upon his limbs. M. Boudet improves upon this treatment by bringing

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the vibrator into actual contact with the surface of the body, or more correctly, with terminal twigs, the affected nerves. He does this by a tuning fork kept in constant vibration through the attraction and repulsion of an electro-magnet, in which an electric current flows, and a rod having one end connected to the fork and the other applied over the nerve. So efficacious does it appear to be that certain kinds of neuralgia, especially in the less deep-seated nerves, are charmed away after a few minutes' use. The subject is yet in its infancy, but it is probable that other kinds of physical suffering may be soothed by the vibratory influence, and it is not unlikely that complete anæsthesia, similar to that produced by chloroform, may result from tremors of the cranium; for when the fork is applied direct to the walls of the skull a swimming in the head, followed by a desire to sleep, is frequently induced. When we see how a simple friction of the skin sometimes moderates a very acute pain we can the more readily understand that a vibration set up in the extremities of the nerves which reach the skin will act in the manner above described. Indeed, there are good reasons for believing that chloroform applied to the skin, electrical shocks, the actual cautery, and other irritants all operate through mechanical disturbance of the sensory nerves.

Glasgow Philosophical Society.—At a recent meeting of this society Sir W. Thomson read a paper on "Gyrostats." He showed a large number of experiments for the purpose of illustrating the tendency that a rotating body has in maintaining its axis in a fixed direction. The instruments used were called "gyrostats." They consisted of a heavy fly-wheel rotating within a fixed case. When the fly-wheel was put in rapid rotation it seemed altogether to disobey the ordinary laws of gravity. Sir William exhibited the fixed case perched on the top of unstable gymbals, and also hung in a thorough unstable position by bifilar suspension. He also illustrated by means of the gyrostat the phenomena of the precession and nutation of the earth, and showed how a string of gyrostats would form a simple representation of Faraday's great discovery of the representation of the plane of polarisation of light in passing through a crystalline transparent medium placed between the poles of an electric magnet. At the same meeting a paper was also read by Professor Blyth on "A Wire Telephone." After defining the construction of the wire telephone, the professor referred to, and illustrated, the observation made by De la Rive as being the earliest and most rudimentary form of wire telephone. He then exhibited the electro sonometer, which consisted simply of a monochord, with a wire stretched between the bridges, through which a current from a tuning-fork interrupter was led. When a powerful electro-magnet was placed astride the wire a loud sound was heard proceeding from it, due to the vibrations of the wire across the lines of force produced by the magnet. Professor Blyth stated that, theoretically speaking, a musical instrument could be constructed on that principle, which would be free from the discords produced by agitating the strings by friction, as in the violin, or by the hammers as in the piano. He also showed how it could be used to reproduce the vowel sounds, as in the Helmholtz apparatus. A novel form of telephone transmitter was shown, consisting of a thin layer of red phosphorus between two parallel plates of brass, to which the electrodes were attached. By means of the galvanometer Professor Blyth showed that that arrangement acted as a voltaic cell, and that the current from it varied under the influence of pressure. The red phosphorus could thus be made to play the double part of battery and loose contact in a telephone circuit.

THE UNIT OF FORCE IN ELECTRICAL MEASURES.

As the subject of electrical units is rising into notice just now, thanks to the presidential address of Professor G. C. Foster to the Society of Telegraph Engineers and Electricians, and the Committee which has been formed by the British Association, the observations made by M. Lippmann, the inventor of the capillary electrometer, to the French Academy of Sciences may not be without their value.

M. Lippmann reminded his audience that the 1863 Committee of the British Association had taken for their unit of force the *dyne*, that is to say, the force capable of impressing on a gramme mass the velocity of a centimetre per second at the end of a second. Is the dyne, then, the very best unit that could be chosen? This is the question which M. Lippmann puts; but, instead of attempting to answer it completely, he contents himself with directing attention to the following considerations.

In the first place, the absolute electro-magnetic units of electric resistance and electric capacity are independent of the choice of the unit of force*; and since these are the only absolute units represented by standards, the *ohms* and *microfarads* scattered among our laboratories would retain their value, however we might vary the unit of force.

In the second place, the formulæ which allow of passing from the absolute electro-magnetic to the absolute electro-static system, or inversely, are all independent of the choice of the unit of force. This is seen by scanning the last line of the table given below. But these formulæ are the only ones of this kind which have a theoretic interpretation.

The units of intensity and electromotive force depend, on the contrary, on the choice of the unit of force. If it was found advisable, for example, to replace the dyne by another unit, the necessary operations for measuring these dimensions would not change, but their numerical result would be expressed differently; it would be necessary to replace the volt and weber by other denominations, for these are simple denominations, and not standards.

We can pass from one system of units to any other by aid of the following table:—

System.	Intensity.	Resistance.	Electromotive Force.	Capacity.
Electro-magnetic	$i = F^{\frac{1}{2}}$	$r = \frac{L}{T}$	$e = \frac{LF^{\frac{1}{2}}}{T}$	$c = \frac{T^2}{L}$
Electrostatic.....	$I = \frac{LF^{\frac{1}{2}}}{T}$	$R = \frac{T}{L}$	$E = F^{\frac{1}{2}}$	$C = L$
Ratios	$\frac{T}{i} = \frac{L}{T}$	$\frac{R}{r} = \frac{T^2}{L^2}$	$\frac{E}{e} = \frac{T}{L}$	$\frac{C}{c} = \frac{L^2}{T^2}$

These remarks show that the unit of force in electrical measurements is not of such importance as one might imagine beforehand, and that it would, consequently, be an easy matter to change it. This being granted, it is a very natural question why the eminent authors of the electro-magnetic system have agreed to measure these forces in dynes. The reason is not far to seek. It is that in order to determine the couple of forces exercised by terrestrial magnetism on a magnetised needle these physicists employed the method of oscillations. When this method is employed an acceleration is what is found by experiment. It is convenient to take accelerations as a measure of the forces which produce them. The dyne has the advantage of a great simplicity in the case of the method by oscillations; but only in this method. But it should be remarked that the method of oscillation is only a roundabout mode, for, to measure a static couple, it had been more direct to employ a bifilar suspension of Gauss, or more generally a static method. But then no acceleration would result; the magnetised needle would only require to be weighed, and the size of the force obtained directly form the weight in grammes.

* For, let OL, T, F, be length, time, and force, measured with any units soever. The quantity of magnetism, M, is given by an equation of the form $\frac{M^2}{L^2} = E$; M is, therefore, of the degree $M = LF^{\frac{1}{2}}$. The intensity i of the current is given by the formula of Ampière, which is of the degree $\frac{Mi}{L} = F$, where $i = \frac{LF}{M} = F^{\frac{1}{2}}$. Finally, the resistance r is given by the equation $r i^2 T = F \cdot L$, of which the two members represent the electric and mechanical work respectively, from which we get $r = \frac{F \cdot L}{i^2 T}$, that is, $r = \frac{L}{T}$; r is, therefore, independent of F. Similarly, the capacity c derived from the charge i T by relation to the electromotive force $e = r$ is of the form $\frac{iT}{ir} = \frac{T}{r}$, and $c = \frac{T}{r}$

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The dyne system otherwise complicates notably the formulæ of transformation; it causes to disappear the advantages of the decimal system in what concerns the measurement of lengths. Some electricians have employed the metre as a unit of length, others the centimetre, and others the millimetre. Suppose we wished to pass from one of these units to the other. On the dyne system, or, more generally, in the systems where force is defined by aid of an acceleration, the units of intensity and electromotive force depend on the square root and the power $\frac{3}{2}$ of the unit of length; so that we are obliged to divide by a factor which must be calculated, and which is either the square root or $\frac{3}{2}$ power of a power of 10. If, on the other hand, we take for unit of force a weight or any other force independent of the unit of length, the unit of intensity is independent of the unit of length. As for the unit of electromotive force, it is, like other electric units, of the first degree in ratio with the lengths. The result is that one can pass from the metre to the centimetre and millimetre by a simple displacement of the decimal point, an operation which can be performed mentally. This is the essential value of the decimal system, and it is renounced by adopting the English units.

To sum up, the electric standards and principal theoretic formulæ being independent of the choice of the unit of force, the choice of that unit has no great importance, and the alteration of it is easy. The dyne has essential advantages in some cases. In fine, it is very desirable that the units which serve to measure time, length, and forces should be the same in electricity as in other branches of physics.

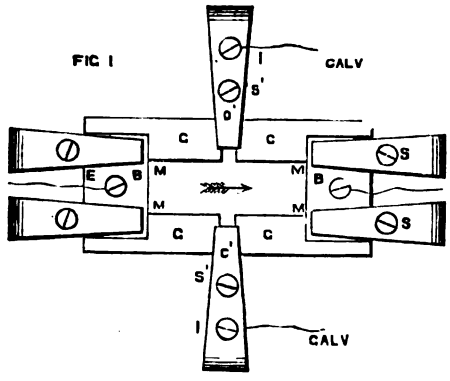
This unification, which was the aim of the British Association physicists in 1863, has not been attained, for there is a decided want of accord in adopting the dyne. M. Lippmann therefore suggests that the ordinary units of the metric system, the metre, gramme, and second should be adopted, the gramme replacing the dyne.

A NEW ACTION OF MAGNETISM ON AN ELECTRIC CURRENT.

In the early part of the winter of 1879 Mr. E. H. Hall (Professor Rowland's assistant in Physics at the John Hopkins University) published an interesting paper in the *American Journal of Mathematics* on some experiments which he had made, proving that an electric *current*, as distinguished from the conductor conveying it, is acted upon by magnetic force in a manner altogether different from that in which ordinary induction is known to take place. The new phenomenon was, in short, the action of a permanent magnetic force on a permanent electric current. Up to that time the new action had been observed only in the case of one conductor, namely, gold, but subsequently Mr. Hall has extended his observations to other conductors, and in the *American Journal of Science* for September of last year his results are given in an elaborate paper which was originally prepared as a thesis for his degree of Doctor of Philosophy.

Most of Mr. Hall's recent experiments were made with an arrangement similar to that shown in Fig. 1, which is about one

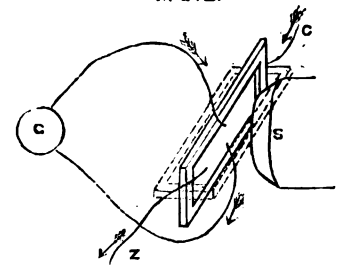
FIG. 1



half the actual size. There *g g g g* represents a plate of glass upon which is mounted the metal strip or conductor *m m m m* which is to be acted upon by the magnet. Contact with this strip is made at the ends by the two thick blocks of brass *b b*, which are held firmly in place by the four brass clamps, worked by means of the screws S, S, S, S. The main current of electricity enters and leaves the metal strip by means of the binding screws *e e*. Running out from the middle of this strip are two projections, which make contact with the clamps C, C_1, worked by the screws S, S_1. From the screws i, i_1, wires lead to the Thomson galvanometer. The projections from the metal strip just alluded to make the apparatus very easy to adjust, for by scraping off little particles from the proper part of the projections, while the current is allowed to run through the metal strip, the current through the Thomson galvanometer may be reduced to the extent desired.

In the ordinary experiments of Mr. Hall the plate above described is placed between the poles of an electro-magnet, in such a position that the direction of magnetic force would be represented by a perpendicular to the plane of the paper in the above figure. This position of the plate is shown by the thick lines in Fig. 2. By reversal of the magnet current a

FIG. 2.



permanent deflection of 30 centimetres could be obtained on the Thomson galvanometer, while the plate was thus placed. On changing the plate into the position of the dotted lines in Fig. 2, and keeping other things the same, no such deflection could be observed. The first part of this experiment therefore exhibits the main fact, namely, that in a conductor subjected to the given conditions, a permanent electromotive force is at once established which has a direction perpendicular to the direction of magnetic force, and perpendicular to the direction of the primary current in the conductor. The second part of the experiment shows that under similar conditions no electromotive force is set up in the direction of the magnectic force, or at least none of the same order of magnitude as that described above.

Another experiment giving a negative result, suggested by Professor Rowland, is worthy of mention. It was to test for an action of the magnet on the lines of static induction in glass. A thick piece of plate glass about four centimetres square was taken, and a hole about four millimetres in diameter was drilled through each of the four lateral faces. These four holes were all directed toward the centre of the glass, and each extended to within about seven millimetres of this point. If the holes had met they would have formed two cylindrical channels at right angles to each other, and extending straight through the glass from lateral face to lateral face. In each hole a loosely fitting plug of brass, several mm. long, was placed and securely fastened with a cement of insulating material. Leading out from each plug was a wire which was insulated for some cm. by being surrounded with a glass tube. The piece of plate glass thus prepared was placed between the poles of the magnet, precisely as a plate bearing a strip of gold would be. One of the brass plugs was placed in connection with the inner coating of a battery of Leyden jars charged by means of a Holtz machine, the opposite plug being in connection with the outer coating of the jars and with the earth. The other two plugs were placed in connection with the separate quadrants of a Thomson electrometer. The quadrants were both insulated from the earth. The electrometer was sufficiently sensitive to deflect the spot of light about 170 mm. for the electromotive force of a Bunsen cell, or 340 mm. on reversing the connections of such a cell. The battery of Leyden jars was charged to a potential sufficient to give a spark of two or three mm. The connections thus made, the position of the spot of light was observed, and the magnet then operated for the purpose of discovering, if possible, any consequent change of position of the spot of light, which would indicate an action of the magnet on the lines of static induction in the glass. The observation failed to establish the existence of any such action. The electrometer being in a very sensitive condition the spot of light was rather unsteady, so that any very slight effect of the kind looked for would not have been detected, though it is probable that, if a reversal of the magnet had caused a change of four mm. in the position of the spot of light, this effect would have been apparent.

We may therefore conclude with Mr. Hall that any change of relative potential in the quadrants of the electrometer caused by reversal of the magnet was probably less than $\frac{1}{80}$ of that caused by reversing the connections of the electrometer with a Bunsen cell as mentioned above. If, now, we estimate the difference of potentials between the plugs A and B connected with the Leyden jars to have been, as indicated by the length of the spark, equal to that which would be produced by 10,000 Bunsen cells in series, we may conclude that any difference of potential between the other plugs C and D which was caused by the action of the magnet must have been less than $\frac{1}{800000}$ of the difference of potential

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between and A and B. We must remember, however, that any change of potential on C and D had to be extended as well over the comparatively large area of the electrometer quadrants. Professor Rowland has roughly estimated the capacity of the quadrants as twenty times that of the plugs C and D. If, therefore, these plugs had not been attached to the electrometer, any difference of potential between them due to the action of the magnet would have been twenty times as great as in the actual case, so that instead of $\frac{1}{800000}$ we have $\frac{1}{40000}$ of the difference of potential of A and B as the superior limit of the difference of potential of C and D which the magnet might possibly have produced if C and D had not been connected with the electrometer. Representing the former difference of potential by E, the latter by E′, and the strength of the magnetic field, about 4,000 (em-grm-sec), by M, we have for this case of static induction in glass $\frac{E'}{E \times M}$, if not zero, is less than $\frac{1}{160,000,000}$.

Turning to the analogous case of current electricity in the various metals, and representing now by E the difference of potential of two points a centimeter apart in the direction of the current, and by E′ the difference of potential of two points a centimeter apart in a direction at right angles to that of the current, while M has the same signification as before, we may write, as a very rough estimate for the case of iron, $\frac{E'}{E \times M} = \frac{1}{1,000,000}$, while for tin the value of the ratio may be as small as $\frac{1}{600,000,000}$. We may, therefore, conclude, says Mr. Hall, that the equipotential lines in the case of static induction in glass, if affected at all by the magnet, are affected much less than the equipotential lines in the case of a current in iron, but we cannot say that any such possible action in glass has been shown to be smaller than the analogous action in the case of a current in tin.

In his first paper in the *Journal of Mathematics* Mr. Hall deduced the ratio $\frac{E}{E'}$ of the difference of potential per cm. on the longitudinal axis of the gold leaf experimented upon, to that per cm. on the transverse axis. Values of this ratio ranging from 3,000 to 6,500 according to the strength of the magnetic field were therein given; and the ratio $\frac{E'}{E}$, M was supposed a constant for all conductors. Subsequent experiments have, however, shown Mr. Hall that this is not the case, and he now expresses his results by the formula $\frac{M \times V}{E'}$, where E′ has the same meaning as before, while M expresses the strength of the magnetic field in cm.—grm.—*sec* units, and $V = \frac{C}{S}$, the strength of the primary current divided by the area of sections of the conductor. This ratio does not prove to be the same constant for different metals, but for any particular metal it seems much more nearly a constant than the ratio $\frac{E \times M}{E'}$ given above would be. The quantity V, it may be pointed out in passing, bears an intimate relation to the absolute velocity of the electricity, for if we were to take as the unit velocity of electricity that of a unit current flowing through a conductor of unit cross-section, the velocity in any particular case would be a quantity $\frac{C}{S}$.

The recent experiments of Mr. Hall were undertaken because doubts about the real nature of the new action were expressed in different quarters. Plates of gold, silver, iron, tin, &c., were tested. One fact obtained is quite inexplicable on the theory of some accidental cause for the phenomenon. The arrows in Fig. 2 show the direction of the transverse current relatively to the direct current in gold, the magnet pole *s* being a south pole, *i.e.*, the pole attracting the north-pointing end of the needle. This relation between the directions of the two currents and the magnetic force is the same in all of the four gold plates which have been examined in this particular. The same uniformity is observed in the four silver plates and the three iron plates which have been tested in the same way. With the two plates of tin which have been examined there has been a trifle of uncertainty upon this point, as the effect in this metal is at best very small; but this uncertainty is hardly sufficient to cast doubt upon the correctness of the rule that, so far as observation has gone, the relative direction of the transverse current is always the same for any particular metal. This uniformity in so many cases could hardly be accidental. The question of direction is evidently one of fundamental importance. It is the same for silver as for gold; but, as Professor Rowland predicted,* it is reversed for iron; and what is very curious, the direction for nickel, which is, next to iron and cobalt, the most strongly magnetic substance known, the direction of the transverse current is the same as in gold. Only iron appears to be an exception to the general rule.

* *Am. Jo. Mathematics*, Vol. II., p. 355.

In the following table the results obtained by Mr. Hall from different metals are collected. Those obtained with very thin strips are marked thus (?), because there is a question as to their accuracy, owing to the difficulty of measuring their extreme thinness:—

Metal Plate	$\frac{M \times V}{E}$.	
Gold, No. 6 ("hard")	152×10^{10}	1515×10^9.
Ditto	150×10^{10}	
Ditto	150×10^{10}	
Ditto	154×10^{10}	
Ditto, No. 5 (soft or semi-cohesive)	161×10^{10}	1625×10^9.
Ditto	163×10^{10}	
Ditto	162×10^{10}	
Ditto	164×10^{10}	
Ditto, No. 4 ("soft")	155×10^{10}	1545×10^9.
Ditto	155×10^{10}	
Ditto	154×10^{10}	
Ditto	154×10^{10}	
Ditto, No. 30, A (semi-cohesive ?)	123×10^{10}	1250×10^9.
Ditto	124×10^{10}	
Ditto	128×10^{10}	
Ditto, No. 30, B (semi-cohesive ?)	139×10^{10}	1400×10^9.
Ditto	141×10^{10}	
Silver, No. 10	114×10^{10}	1160×10^9.
Ditto	118×10^{10}	
Ditto, A (deposited)	134×10^{10}	1355×10^9 (?).
Ditto	137×10^{10}	
Ditto, B (deposited)	—	1350×10^9 (?).
Iron, C	-127×10^9	1285×10^8.
Ditto	-130	
Platinum	—	4170×10^9.

Nickel: Effect large, possibly as strong as iron.

Tin: Effect probably much smaller than in platinum.

The representative numbers deduced by Mr. Hall from these results are as follow:—

Iron	78·
Silver	8·6
Gold	6·8
Platinum	2·4
Tin	·2 (?)

Of course, the magnitude of the new action in different metals may be considered in connection with other physical properties as well as electrical resistance, for example, the known magnetic or diamagnetic properties of the metals. It is remarkable, indeed, that iron, the most magnetic substance, shows the effect in the highest degree. With gold and silver the magnitude of the action is out of proportion to the magnetic capacities of these metals. At present we cannot be sure that any relation has been detected between the magnitude of the new action and any known properties, but it is probable that it will give us a new insight into the molecular structure of bodies and the nature of electricity. It is, says Mr. Hall, perhaps idle to speculate on the exact manner in which the action between the magnet and the current takes place in any of the preceding experiments, but it may be worth while to remark a seeming analogy, somewhat strained perhaps, between this action and a familiar mechanical phenomenon the theory of which has of late attracted considerable attention. It is well known that a base-ball, projected swiftly through the air, and having at the same time a rapid motion of rotation about its vertical axis, does not throughout its course continue in the original vertical plane of its motion, but follows a path curving sensibly to one side. Imagine, now, an electrical current to consist of particles analogous to the base-ball moving through a metallic conductor the electrical resistance of which will correspond to the mechanical resistance offered by the air. Suppose, further, the particles of electricity, on coming within the influence of the magnet, to acquire a motion of rotation about an axis parallel to the axis of the magnet. Under all these supposed conditions we might perhaps expect to find the action which is actually detected. To account for the reversal of the action in iron, we might suppose the particles of electricity to acquire in this metal a rotation about the same axis as in the other metals, but in the opposite direction. Even after all these generous concessions in favour of our hypothesis, however, it fails to account for the behaviour of nickel as different from that of iron. The analogy is rather curious than significant.

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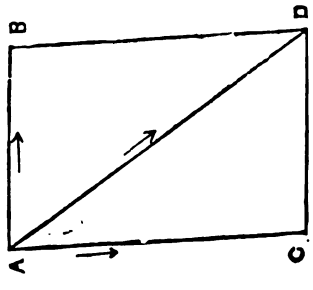
LESSONS FOR LEARNERS.

(CONTINUED FROM PAGE 165.)

We will now vary our experiment a little, and try to find out the direction in which the box moves when the weights are not hung in the same or in opposite directions. One weight now hangs over the end, and one over the side of the table. The box moves, as you see, but not in the same direction as either weight. If we try with different weights, and hang them to act in different directions, we shall find that the box when it moves always moves in a direction between the directions in which the weights act. For a complete investigation of this result I must refer you to books dealing specially with the subject. We shall not just yet require a very profound knowledge of statics or kinetics. You must, however, try and follow me a little further. I can move this box by pushing at this, or that, or a hundred other points, or by pulling at this string, fastened here, or there, or at any other point I choose. A force must act in a certain direction, and from a certain point; it must also be of a certain magnitude. In talking about forces it is well to have them represented in order that the eye may assist the ear, and in other ways lessen our labour. Straight lines are used to represent forces, for they can be drawn in any direction, from any point and of any length, so that they represent the direction, point of application, and magnitude of forces. A certain length, as agreed upon, may be used to represent a lb., cwt., ton, &c. Twice that length will represent 2 lbs., 2 cwts., 2 tons, &c., and so on. Again, you will see that we can use one, or two, or three or more forces to perform certain operations; but it is evident that, in most cases, if more than one force is used, they could all be replaced by some one force sufficiently great, and acting in the right direction. This one force that can be used to act in the place of two or more is called the *resultant* force, or briefly the *resultant*.

It is easy in a great many cases to calculate the value of the resultant. Indeed, we have just seen that when two forces act on a body in opposite directions the resultant, so far as regards magnitude, is equal to the difference of the forces, and as regards direction acts in the same direction as the larger of the two forces.

If we agree to represent forces by straight lines, it is shown in the text books that if two forces are represented in magnitude and direction by the adjacent sides of a parallogram, the resultant force will be represented in magnitude and direction by the diagonal of the parallelogram. Here is a very simple case. Let A B, 3 mm. long, represent a force acting at the point A in

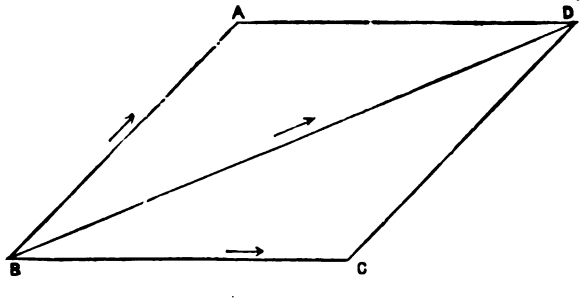


the direction A B of 3lb. Let A C, 4 mm. long, represent a force acting at the point A in the direction A C of 4lb. Suppose A B and A C to be at right angles to each other. The resultant of these two forces, or the one force that could replace the two yet produce the same effect, is represented by the diagonal A D, 5 mm. long, in direction and in magnitude.

The arithmetical work in this simple case is—

$$\sqrt{3^2 + 4^2} = \sqrt{25} = 5.$$

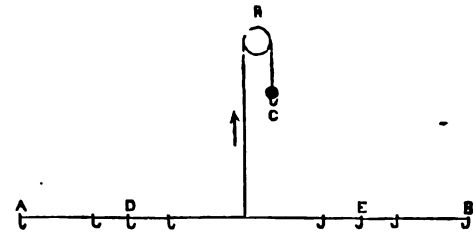
The calculations required when the angle is a right angle are



very simple, and they become more difficult according to the angle at which the forces act. Many calculations, however, can be made by simple measurement, sufficiently correct for all practical purposes. Thus, if BA, BC represent forces acting at an angle of 45°, the diagonal BD will represent the resultant. Let 1mm. in length represent 10lbs. in force. On measuring I find BA BC each equal 4·5mm., that is, each represents a force of 45lbs. I find BD = 8·3mm. that is, represents a force of 83lbs., an answer fairly exact.

Our immediate object, however, leads us to consider forces acting on a body in directions more or less parallel. Generally such forces have a resultant, but we shall see there is a particular case when there is no resultant.

Here is a rod, AB, which I suspend by a string over the pulley, and balance by the weight at C. The point of suspension is F, and we may term the parts of the rod on each side the arms FB, FA. A number of hooks are provided on which to hang weights. The weights I have are all equal. I hang 1lb. at B and 1lb. at A, the distance FB being equal to the distance FA, and I find I must hang 2lbs. at C to prevent motion. The one force of 2lbs. at C is equal to the resultant of the two forces at A and B, but acts in an opposite direction. The rod AB is all the time parallel to the floor. I move the weight from B to E, and you see that although the point F does not move upwards, the arm FE does, while FA goes down. In order to keep the bar parallel I must hang another 1lb. weight at E. Now we have 2lbs. at E and 1lb. at A, but to balance this I must add another 1lb. at C, making 3lbs.



at C. On measuring we find F E = ½ F B or ½ F A. From numerous experiments of this kind, we gather that the weights at C acting upwards must be equal to the *sum* of the weights acting downwards if the point F of the bar is to remain in the same position, and that the length of the arms F A, F D, F E, F B, as well as the weights on the arms, have something to do with the motion of the arms about F. It is found by mechanical principles that if the force at B or at E, &c., multiplied by the length of its arm be equal to the force at A or at D, &c., multiplied by the length of its arm, there will be no motion of the arms about the point F. "The product of a force into a perpendicular, dropped from the fulcrum (as the point of suspension F is termed) upon its line of action, is called the *moment* of the force; and, hence, when there is equilibrium, the moment on the one side is equal to that on the other."*

Thus, let F A, F B = 3mm. respectively.
While F D, F E = $\frac{3}{2}$mm. respectively.
In the first case, $1 \times 3 = 1 \times 3$.
In the second, $2 \times \frac{3}{2} = 1 \times 3$.

These moments being equal, the result is equilibrium about F. We have also seen that the resultant of two parallel forces acting in the same direction is equal to the sum of the forces, and acts in the same direction as the forces, for we put one force in an opposite direction to the two forces which first prevented any action. The one force we used then was just equal to, but opposed in direction to the one force that would have produced the same effect as the two. We might similarly show that the resultant of two unequal forces, parallel, but in opposite directions, is equal to the *difference* of the two forces, and acts in the direction of the larger force.

"There is one case in which we are unable to find a single resultant for two parallel forces, namely, when the forces are *equal* and *unlike*. . . . Two such forces are usually called a *couple*. . . . A *couple* consists of two parallel forces which are *equal* and unlike. The *arm* of a couple is the perpendicular distance between the lines of action of its forces. The *moment* of a couple is the product of one of the equal forces into the arm; that is, the number which expresses the force must be multiplied into the number which expresses the arm to produce the moment. The student will readily conceive that the *tendency of a couple which acts on a free rigid body is to make the body turn round.*"†

After so long a digression we will return to our galvanometer, and have it back on the table.

---

* "Lessons in Elementary Physics." By Professor Balfour Stewart, LL.D., F.R.S.

† "Mechanics for Beginners." By I. Todhunter, M.A., F.R.S.

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THE ELECTRICIAN.

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RADIOPHONY.

We have on several occasions referred to the state of opinion in France with regard to the photophone, hardly any countenance being given there to Professor Bell's own account of the action of the beam of light. It is the heat rays, according to most French scientists, that produce the sound, and several learned professors have undertaken to prove conclusively that heat will do all that light was supposed to do. M. Mercadier is hardly an exception; but he has shown his discretion in naming the subject *radiophony*, so that the *kind* of radiation is allowed to be an open question. His experiments, though very numerous, appear to have been confined to solid bodies. He found that their sonorous action under a beam of light depends greatly upon the nature of their surface, everything tending to diminish their reflecting power and to increase the absorbing power of the surface augmenting the sounds. The maximum effects are, M. Mercadier alleges, produced by the red rays and by the invisible ultra red rays, differing in this respect from the action of selenium, which is affected chiefly by the yellow and green-yellow rays. The conclusions to which these observations would seem to point have now been supported by an eminent countryman of our own, whose account of his recent experiments is just now exciting much interest.

It will be remembered that at the time Professor Graham Bell exhibited his photophone in this country Professor Tyndall was experimenting in relation to the interaction of radiant heat and gaseous matter, and that he at once employed the new apparatus on the objects whose properties he was then investigating. From the first he was of opinion that the sounds in Mr. Bell's photophone were caused by rapid changes of *temperature* producing corresponding changes of shape and volume in the bodies impinged upon by the beam. This view was confirmed by the experiment performed in Mr. Bell's presence, when an absorbent gas was made to emit sound by the action of a ray of light. It may here be observed that the work Professor Tyndall was then engaged upon was to prove that certain gases really absorb radiant heat, and it seemed likely that they would emit sounds more intense than those obtainable from solids. The photophone, therefore, afforded him a new means of bringing his previous conclusions to the test. From a flask containing the gas or vapour to be operated upon was led an india rubber tube with tapering ivory or boxwood earpiece, and any sound generated within the vessel was thus rendered audible. A Siemens electric lamp was used for obtaining the rays, and a modification of Mr. Bell's device for interrupting them served to maintain a succession of shocks upon the flask. Finding that the glass lenses withdrew from the beam its most energetic rays, he reverted to the use of silvered mirrors, sometimes singly, sometimes as conjugate mirrors, and with these Professor Tyndall obtained results which are extremely curious and striking.

It was shown, beyond all doubt, that the vapour, and not the liquid below it, was the sonorous body. In no case could sound be obtained from the liquid, whilst the vapour invariably responded to the pitch of the beam, its loudness depending entirely upon the absorbent character of the vapour. Sulphuric ether and the like gave off very loud musical tones, whilst chloroform and bisulphide of carbon, which are diathermanous vapours, responded very feebly. Experiments with gases pointed to the same conclusions. With dry air, dry oxygen, or hydrogen, hardly any sound could be obtained; but turning to carbonic acid and nitrous oxide the sounds grew in strength until with olefiant gas they became as loud as those of an organ pipe. This is the exact order in which Professor Tyndall had placed these gases as absorbers of radiant heat. But the most remarkable and unexpected results are to follow. Hot aqueous vapour—even when perfectly invisible—emitted a powerful musical sound; at the other extreme of temperature the same result was obtained from the cold vapour, and even a puff of breath from the lungs sufficed to produce the sound.

Thus far, however, the experiments could not be regarded as proof that the effects were due to heat and not to light; and this is the point of most interest in regard to the photophone. With a view of determining this question, Professor Tyndall interposed a layer of water or other suitable liquid, with the result that the intermittent beam was rendered powerless; on the other hand, a layer of bisulphide of carbon tinged with iodine interfered but very slightly with the action. The efficient rays must have been intercepted by the transparent layer, and were therefore heat rays; the opaque layer afforded a converse proof that they were not light rays.

Subsequent experiments made it perfectly evident, at all events, that heat without any light rays at all would give rise to all the observed phenomena. Abandoning the electric light, and using successively lime light, a candle, and a red hot coal, the experimenter found that a poker at about the temperature of boiling water, and, of course, giving off no visible rays, produced the sounds hitherto attributed to light—the lowering of the temperature causing a gradual

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diminution of sound. In these later experiments the source of heat was brought close to the rotating interrupter, whilst with the beam of light the extreme distance at which sounds could be produced under the conditions described by Professor Tyndall was 100 feet.

Those, however, who favour the light theory for explaining the action of the photophone will find something to confirm their views in Professor Tyndall's final experiments with liquid bromine, the brown vapour of which, contrary to expectation, was found to be musical. Lime light was here employed, and the upshot of a variety of subsequent tests showed that in this instance the light rays were the effective agents. On the whole, while it would appear certain that heat is capable of playing the part assigned to light by the discoverer of the photophone, it is, as yet, by no means certain that light can convey "rapid changes of *temperature*" at distances traversed and under the conditions employed in Mr. Graham Bell's experiments. In other words, while it is plain that the action in Professor Tyndall's and M. Mercadier's investigations may be rightly described as thermophonic, it by no means follows that the effects obtained by Mr. Bell are not photophonic—radiophonic is a broader term, including both, and the only term that for the present it is safe to employ.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

FEB. 10, 1881.

The following is a full report of Professor Perry's speech, which we promised in our last issue:—

Professor J. PERRY said: The great value of the paper we have heard lies in its being an exact record of continuous observations, and it is to be hoped that the complete curves will be published. From the diagram, for three days the lunar semi-diurnal periodicity is not very evident, but there can be no doubt of there being two positive maxima and two negative maxima in a solar or lunar day. Very little good is to be derived, I am afraid, from theorising on the causes of earth currents until at every telegraph office a continuous record is kept, so that maps of equipotential lines may be drawn all over England. In a paper read in Japan in May, 1877, Professor Ayrton and I referred to Mr. Varley's predictions of bad weather derived from earth currents, and to the fact that earthquakes are known to be accompanied by greater intensities of these currents, and we designed a recording instrument which might be placed in any telegraph office, and which would neither interfere in any way with the ordinary working of the line nor require any attention from the telegraph operator. At that time we wrote a paper on "Rain Clouds and Atmospheric Electricity," which has since been published in the *Philosophical Magazine*, in which we referred to the result of certain elaborate calculations made by us on electric tides and consequent earth currents due to electro-static induction from heavenly bodies. At the end of our paper, "A New Theory of Terrestrial Magnetism," read before the Physical Society two years ago, we say:—"In the preceding investigation we have supposed the electric charge to be uniformly distributed over the earth, and so have arrived at a law of magnetic intensity merely varying with the latitude. But the sun and other members of the solar system may very likely have potentials so different from that of the earth that we can hardly conceive the amounts; consequently, we should expect the static electric distribution of the earth would undergo periodic changes corresponding in times with those of the ocean tides. But alteration in the static distribution of electricity on the earth's surface means, as we have shown, alteration in the law of magnetic intensity; consequently, we should expect that this magnetic intensity would vary somewhat as do the ocean tides; and this is known to be the case. But it is also evident that, besides these regular changes, every time a great mass of vapour is suddenly formed and condensed on the earth, and whenever great changes are occurring in the solar atmosphere whereby the lines of *electro-static induction* from the sun to the earth are altered we should find corresponding changes in terrestrial magnetism such as we now know as magnetic storms. And not only this, but as the planets are charged bodies, their motions relatively to the sun ought to cause motions in the sun's atmosphere, such that, for instance, the allineation of a number of planets and the sun, or the near approach of any planets, if the alligned or approached planets have potentials nearer that of the sun than many of the other bodies of the solar system, ought to diminish the storms in the solar envelope, and ought to alter the electrostatic distribution on the earth."

Since that paper was published it has been shown by Professor Rowland that the change required on the earth to produce by its rotation alone the earth's magnetism—namely, five-and-a-half micro-farads per square centimetre, or $5{\cdot}6 \times 10^{-6}$ farads, is so great that this idea must be given up. I have not time now to consider whether or not it might not still be put in a workable form by assuming some other distribution than a merely superficial one; but in its original form we have given it up, because the greatest superficial change which might reasonably be allowed for the earth will only suffice, by mere rotation, to account for the one-thousandth part of the earth's total magnetism. Even to produce this small effect the outward pressure at the surface of the conducting earth would be as much as the one-sixhundreth part of an atmosphere. Possibly this is the greatest outward pressure which we are likely to be granted. If an outward pressure of one-sixth of an atmosphere were allowed we could account on our theory for one-hundreth of the total magnetism of the earth. We relinquished this idea, then, on account of the great pressure outwards to which the surface of the earth would be subjected if the charge were great enough to produce the whole amount of terrestrial magnetism. We did not relinquish it on account of Professor Rowland's statement that "If the moon was electrified to a like potential the force of repulsion would be greater than the gravitation attraction to the earth, and it would fly off through space," because this is not the case. The mutual gravitation attraction of the earth and moon is $1{\cdot}886 \times 10^{25}$ dynes, and their repulsion when charged to the required potential is $1{\cdot}401 \times 10^{24}$ dynes, or about fourteen times less. And in addition we should never have proposed to give to the moon as high a potential as it is possible to give to the earth, since the greater the radius of the sphere the greater may be its potential for the same pressure outwards. The resultant attraction between the earth and moon is known, but who can positively say that it is altogether gravitation. The repulsion of charges of electricity on spheres very distinct in comparison with their diameters will have exactly the same effect as a diminution of the mean densities of the spheres would produce on the total attraction, as it is very probable that the charges of all bodies of the solar system have the same sign.

As we informed the Physical Society a year ago we do not propose to relinquish that part of our theory which deals with changes in the earth's magnetism, and with earth currents in telegraph lines. For if the density at any place changes by an amount equal to the one twelve thousandth of the charge which Professor Rowland states that our theory requires, there will be produced at the place a change of nearly this fraction of the earth's total magnetic force (this is the amount required by actual magnetic observations), and such a change of density as this is quite allowable, since the pressure outwards due to it is less than the twelve millionth part of an atmosphere. It is, however, somewhat difficult to see how this excess density is to be produced, for if the moon has a charge m, if f is the distance from earth to moon, if Ψ is the angle made by the earth's radius at a place with the line of centres, then whether or not the earth has an independent charge σ, the fluctuating density at the place is very nearly $\sigma = \frac{3m}{4\pi f^2} \cos \Psi$.

It will therefore be seen that if the moon is to produce the change of density necessary to produce on our induction theory the actually observed lunar-diurnal change in the intensity of the earth's magnetism, its charge must be very considerable indeed. I have no time to pursue this subject further at present, but let me say that, whatever be our ideas as to the sufficiency of the theory to explain fluctuations in terrestrial magnetism, there can be no doubt of its sufficiency to explain earth currents.

It is obvious that Mr. Adams is wrong in giving to the earth on the side of the moon a charge of the same kind as that which exists on the side away from the moon. It has to be remembered that the ocean tide on the side away from the moon is due to the inertia of the water acted upon by the centrifugal force due to the earth's rotation round the centre of gravity of earth and moon. There is no analogy to this in the case of electricity. According to our theory there would only be one positive and one negative maximum in the intensity of terrestrial magnetism every twenty-four lunar hours. He finds twice as many maxima, and we should be inclined to put this down to local circumstances. It is probable that the oceans of the earth possess always the static charges necessary for their positions with

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respect to the moon. But over the more non-conducting land the necessary distribution cannot be effected quickly enough, and hence we get differences of potential which go under the name of "earth currents." If this is true, then the coast line of England is nearly an equipotential line, and the greatest earth currents will be obtained from the most inland place to the sea coast. In India, I understand that the earth currents are mainly in one direction. Mr. Adams finds from Cardiff to London two maxima in one direction and two in another, the differences of potential being exceedingly small. Other observers have found other results in other places, but as in all a periodicity is observed which is diurnal or semi-diurnal, it is probable that local causes will account for differences, just as differences in the periodicity of the ocean tides are due to local causes, the exciting agent in every case being the static induction from the moon and sun.

In calculating the earth current effect, we find our smallest result, that is, no earth currents, when we consider the earth to be perfectly conducting; we therefore look at the problem in quite a different way from Mr. Adams. We find our greatest result when we consider a perfectly non-conducting earth. With a newly non-conducting earth, a comparatively small charge on the moon will produce very considerable differences of potential. In this case the earth's own charge would in the course of time have arrived at a stable state of distribution. The potential at a point P on the earth, due to a charge m on the moon, would evidently be

$$\frac{m}{MP},$$

M being the moon's centre. The electromotive force in the direction of the steepest gradient (this direction changes with a diurnal periodicity) is $\frac{m}{f^2}$ sin Ψ per centimetre, Ψ being the angle made by the earth's radius at the place with the line of centres; so that during the lunar day we find the electromotive force changing from $\frac{m}{f^2}$ to $-\frac{m}{f^2}$ per centimetre. One volt per mile would be produced by the moon having the easily allowable charge of 10,000 farads. The greatest positive and negative currents would be found at places where the moon is rising or setting, whereas, at lunar noon, and midnight, there would be no earth currents. I have not troubled you with an account of the much more complicated problem which was taken up by Professor Ayrton and myself, the earth being what it is, a moderately good conductor. The result is somewhere between the results for the two limiting cases which I have given. It is quite evident that the moon's induction is quite sufficient to account for very considerable earth currents, whatever may be our difficulties in the co-ordination of the phenomena of terrestrial magnetism. It is, however, quite evident that we must consider local circumstances as modifying the phenomena.

With reference to the connection between earthquakes and these phenomena, there seems to be no doubt that the intensity of the earthquakes continuously producing the earth crackling which is heard from the buried telephones of my friend Professor Milne, follow a lunar periodicity. This earth crackling is undoubtedly due to elastic tides.

SELENIUM AND TELE-PHOTOGRAPHY.

Although the ingenious guesses which were hazarded in anticipation of the photophone when first it began to be talked about proved to be wrong, it is evident that in more than one quarter the idea of electrically transmitting photographic images by means of selenium had received a good deal of attention. Three weeks ago* we gave, for the first time in this country, an account of M. Senlecq's researches in this direction, and the apparatus he has devised is, perhaps, the most elaborate that has yet been made public. Foremost amongst the workers on selenium in this country is Mr. Shelford Bidwell, whose latest contrivances for tele-photography are described in *Nature*, Feb. 10. Before describing that gentleman's invention we may, however, remind our readers that Professor Sylvanus Thompson has added materially to our stock of information concerning the properties of the curious metal which plays so prominent a part in this class of instrument. With a given maximum of incident light distributed uniformly over the surface, the change of resistance in a selenium receiver varies proportionally with its linear dimensions.† For this and other reasons Professor Thompson argues that the cells should be as large as possible, and the light distributed over them uniformly, not focussed to a point. A conical mirror would also be better than a parabolic mirror to receive the beam, as there would then be a minimum loss by reflection, and the light would fall perpendicularly on the cylindrical cell parallel to its axis. To Mr. Andrew Jamieson, of Glasgow, appears to be due the construction of a transparent cell useful for lecture purposes, as it can be made to encircle the chimney of a gas jet. Two parallel wires are wound upon a piece of glass tubing, and the interstices filled with vitrious selenium. The "singing" of the jet, which can be actuated vocally by means of a mouthpiece connected with the gas pipe, may thus be transmitted and received at a distance telephonically.

Turning, now, to Mr. Bidwell's application of the selenium cell to practical purposes, we may first of all congratulate him upon his adoption of the term "tele-photography," which, although rather cumbersome, is more "catching" than the ambitious "telectroscopy" of M. Senlecq. The plan adopted by Mr. Bidwell is a modification of the Bakewell copying telegraph plus the selenium cell. The currents from the batteries B and B′ (Fig. 1)* are brought to zero by the resistance R. Any variation of light falling upon the cell will therefore disturb the current through P, a platinum needle in contact with sensitised paper on M, upon which a brown mark will then be made. It will be obvious that if the needle is caused to move, or the paper to move under it, lines broken or continuous will appear on the paper corresponding to the light allowed to fall upon the cell. On January 5th the experimenter succeeded in tele-photographing the image of a gas flame in that way.

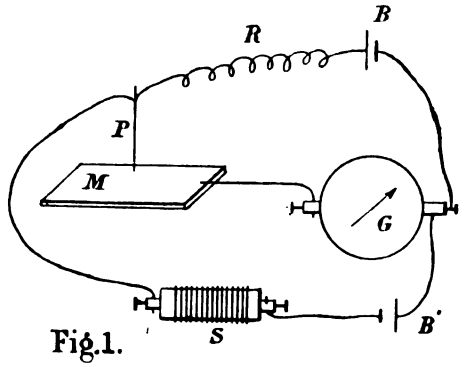

Fig. 1.

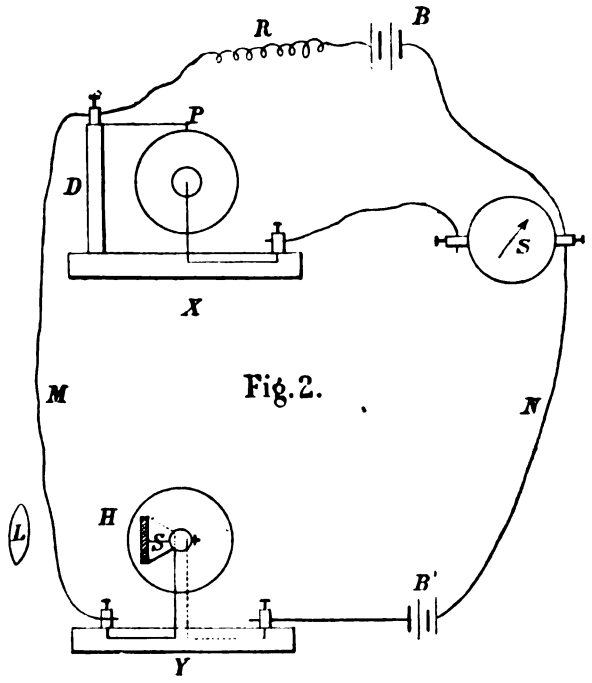

Fig. 2.

A subsequent and more perfect instrument is shown in Fig. 2, where P and S are worked by spindles similar to that of the phonograph. In the cylinder H is a pin-hole, through which a ray of light falls upon the selenium cell enclosed. The receiving instrument shown at X is a similar cylinder covered with sensitised paper. Zero being obtained on the galvanometer by means

* *Electrician*, Feb. 5, 1881.

† *Physical Society*, Jan. 22, 1881.

* For the figures illustrating this description we are indebted to our contemporary *Nature*.

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of the resistance coils, and the image to be operated upon being duly projected by a magic lantern, the two cylinders are made to rotate slowly and sychronously. The pin-hole at H in the course of its spiral path will cover successively every point of the picture focussed upon the cylinder, and the amount of light falling upon the selenium will be proportional to the illumination of the particular spot of the projected picture traversed by the pin-hole. A series of lines resembling an engraver's "tint" results from this operation, broken exactly where the illuminated object is broken. The *shape* is, therefore, tele-photograped, but apparently nothing beside the shape. Mr. Bidwell conjectures that with more perfect appliances a monochromatic counterpart of the original may be produced. Gradation is what is to be aimed at, and we sincerely hope that Mr. Bidwell may succeed in obtaining it.

CORRESPONDENCE.

THE PHOTOPHONE ANTICIPATED.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: It may be rather late in the day to trouble your readers with theoretical ideas on the problem, how to transmit the voice by means of light; but still, even at the risk of being called bad names, I cannot help describing the evolution of the photophone as it occurred to me last June, soon after reading in your columns the first vague rumours of Professor Bell's discovery. Had I imagined I was so near the immortality which a capital discovery bestows I would at once have published my ideas, but a cold prudence restrained me, saying, "There may be nothing in the idea; wait till you can try it." Alas, I have waited too long. Professor Bell has completely forestalled me, and I must now be content with telling my story, and trusting to the generosity of my fellows to believe it and award it some meed of praise.

Briefly, my ideas ran as follow:—Connect in one circuit a telephone, a voltaic battery, and a bar of selenium, which latter should be protected as much as possible from the light. Take a piece of looking glass, in which the sun or other strong light is reflected, and so manipulate it as to throw on the selenium long and short flashes to represent the Morse alphabet. These flashes of light will be converted in the telephone, by a process which I need not describe, into sounds which can be read by any expert clerk. I soon saw that there was nothing gained by this, for an expert clerk could just as easily read the flashes themselves, as, in fact, he does in the heliograph. A little reflection then showed me that if a light mirror, delicately poised on a horizontal axis, be connected by a light rigid bar to a vibrating membrane (the centre of the latter being joined to the highest point in the periphery of the former), it (the mirror) would transmit, as flashes of light, whatever vibrations were imparted to the membrane, and thus a word spoken at the latter might be conveyed through the instrumentality of light to a distance, and there reproduced in a telephone.

A perusal of Professor Bell's paper read before the American Association for the Advancement of Science, and recently published in your columns, will show how closely I was treading in his footsteps.

I may add, in conclusion, that a change of stations from north to south of Persia, and the general upsetedness which such a move entails, have prevented me putting my ideas in writing until now.

J. J. FAHIE.

Shiraz, January 8, 1881.

SWAN'S ELECTRIC LAMPS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Under the head of a "Pertinent Question," you quote an enquiry which lately appeared in the *Newcastle Daily Chronicle* as to what becomes of the electric light at Craigside "when the brook is frozen."

The answer is as simple as the question is plausible. There is always sufficient water beneath the ice to drive the turbine, and it would indeed be bad engineering if that machine and its supply pipe were not secured against the action of frost. With equal show of reason I might ask what would become of the water supply to London if the Thames were frozen. A mountain brook, like mine, is not more liable to freeze than a lowland river, and when it does freeze it kindly behaves like other brooks in freezing at the surface only.—Yours, &c.,

W. G. ARMSTRONG.

Newcastle-on-Tyne, 20th February, 1881.

SUBMARINE TELEGRAPH COMPANY.

The half-yearly general meeting of this Company was held on the 23rd inst., at the City Terminus Hotel, under the presidency of the chairman, Sir James Carmichael, Bart.

The SECRETARY (Mr. S. M. Clare) read the notice convening the meeting, and the report of the directors was taken as read. It stated that the gross receipts for the six months ending the 31st December last amounted to £67,237, and on comparing this sum with the receipts for the six months ending the 31st December, 1879, there would be found an increase of £5,924. This increase arises partly from the amount payable to the Company by the Paris and New York Telegraph Company, under the agreement referred to in the last report of the Directors, but chiefly from the ordinary sources of traffic. In the half year ending 31st December, 1879, the word rate was restricted to Germany and Holland, and 939,892 messages were transmitted, while in the corresponding period of the year 1880 the new tariff was applied to the correspondence of the whole of Europe, and the number of messages transmitted amounted to 1,370,977, showing an increase of 431,085 messages, and producing an additional revenue of £3,800. They had added 10 per cent. of the gross receipts, £5,592 19s. 5d., to the reserve fund, in lieu of 5 per cent., in accordance with the resolution passed at the last meeting of the proprietors; and the net result of the half year's business enabled them to recommend a dividend at the rate of 19 per cent. per annum, and to carry over a balance of £968.

The CHAIRMAN, in moving the adoption of the report and accounts, reminded them that the report presented at the last meeting stated that, while they had had a considerable increase of messages, there had been a slight diminution in the receipts. Now, however, he was happy to point out that in the present report it was shown that there had been a considerable increase both in the number of messages transmitted and receipts. This he thought was a very satisfactory termination of the six months' work, and it proved that the anticipation of the working of the word-rate system had fully realised what was always expected of it by the original promoters of the word tariff. At the last meeting they would remember that the shareholders decided on placing 10 per cent. of the gross receipts to the reserve fund in lieu of the 5 per cent. which it had previously been their custom to transfer to that fund. This was not a suggestion of the board, but came from the body of the shareholders, and the directors had carried out the resolution. At the same time it might be satisfactory to them to know that if on that occasion they had carried only 5 per cent. of the gross receipts to the reserve fund they would have been able that day to recommend a dividend at the rate of 21 per cent., and to carry over a balance of about £400. He wished them all thoroughly to understand that that would have been their position, but he thoroughly agreed with the proposal to carry 10 per cent. to the reserve fund instead of 5 per cent., for, as a shareholder, he considered that the reserve fund was the backbone of the Company. Of course, this Company was in a happier position in regard to the liability of great losses than the deep sea cable companies, because all the Company's cables were laid at such a depth that they could be easily picked up and repaired; but they must not forget that cables would wear out and require renewal, and sometimes renewals might be costly. The reserve fund might, therefore, be hereafter very valuable, and it could be drawn on legitimately to assist them in such renewals, which would otherwise press very heavily on revenue. He considered they had taken a very wise step in this matter—in increasing the provision made to the reserve fund. With regard to their new offices, he congratulated them on having taken possession of them. Their removal to them was effected in a manner which reflected great credit on every one connected with the company—their secretary, the superintendents of the engineering and electrical departments, and their staff. Everything was done without the slightest delay in a single afternoon, and he believed there was not a single minute's delay in the transmission of messages between London and Paris and the Continent. The offices themselves were most admirable. They had pneumatic tubes connected with the Stock Exchange, and no delay was caused in the transmission of messages—in fact, Stock Exchange gentlemen forwarded their messages just as quickly from the present offices of the company in Throgmorton-avenue as they did before from Threadneedle-street. He now wished to refer to a matter in connection with which he hoped they would have the hearty approval and support of the proprietors. The Company had been established now for nearly thirty years, and he thought the time had arrived when some fund ought to be formed for the assistance of the staff, whether in illness or death, for they had served the Company well and faithfully for so many years. He also thought it would be a wise thing to do, in order to encourage their younger *employés*, who had come into their service later, and induce them to stop with the Company. In all the speeches made by General Sir Frederick Roberts, in reply to the honours bestowed on him, he had said that the soldiers under him must also be remembered; and the directors might make a similar remark about the staff of the Company. In a very great measure they were enabled to recommend the shareholders a dividend of 19 per cent. owing to the exertions of the staff. He himself could speak most conscientiously as to the work they had done, for he was constantly in the office. It was a question of which proper legal notice must be given, and, therefore, nothing could be done on that occasion, except that he should like them to express their approval of what he had stated, and by the next meeting they would be able to elaborate a plan and bring it before them. It had been done in other companies to a considerable extent. The Anglo-American and the Eastern Companies, he believed, paid something like £2,500 a year, and the Eastern Extension Company £1,500 a year towards the funds which had been established in their companies; he believed they were insurance funds; but in the case of this Company he did not anticipate the necessity of an insurance fund. What he looked forward to was rather a relief or endowment fund. Of course, their capital was not so large as in the case of the companies he had mentioned, and, therefore, he should not ask them for such a large amount, but something proportionate to the benefit they were deriving from the Company ought to be done for those who were serving them so well. He concluded by moving the adoption of the report and accounts.

Mr. FORD (shareholder), in seconding the motion, spoke in favour of establishing such a fund as that referred to by the Chairman, and thought they had been rather dilatory in the matter. He remembered when the

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Company's stock was at 50, and even then he received a fair interest on his money, but since then they had had very large dividends indeed; and he felt that the efforts of the staff who had served them so well should be recognised in the manner indicated by the Chairman.

Mr. TOWNE asked if there was any chance of the French concession being continued. He approved the suggestion as to establishing a fund for the benefit of the staff.

The CHAIRMAN expressed his satisfaction that everyone present seemed in favour of the proposal he had mentioned on behalf of the staff. As to Mr. Towne's question, they were all most anxious to obtain a renewal of the concessions they had, but no one could anticipate what would happen eight or nine years hence. They hoped for the best, and it would not be for the want of exertion on the part of the directors if they were not in as good a position at the expiration of the concession as they were now. The report was then unanimously adopted. Continuing, the Chairman moved the declaration of the dividend at the rate of 19 per cent. per annum, less income tax, payable on the 1st of March.

The Hon. ASHLEY PONSONBY seconded the motion, which was carried unanimously.

Mr. CAPPER thought it would facilitate the matter if a resolution were passed instructing the board as to the establishment of a fund for the staff. He therefore moved, "That the board be requested to prepare a scheme to be submitted to the proprietors at the next meeting, for providing a fund for the benefit of the staff."

Mr. BOYS seconded the motion, which was carried unanimously.

A vote of thanks to the chairman and directors terminated the proceedings.

MEDITERRANEAN EXTENSION TELEGRAPH COMPANY (LIMITED).

The forty-seventh ordinary general meeting of the shareholders of the above company was held at the City Terminus Hotel, Cannon-street, on the 24th inst. Sir James Carmichael, Bart., chairman, presided.

The SECRETARY (Mr. E. Tombs) read the notice convening the meeting.

The report of the directors for the half year ending 31st December last stated that there was a decrease in the traffic to the amount of £250, attributable in some degree to the operation of the word tariff, which had scarcely answered the expectations of the change from the previous rates. The amount to be claimed under the guarantee would, therefore, be proportionately heavier than for the previous half year. The Company's cables were in good order, and the cost of repairs and maintenance had been light. They proposed the payment of the usual dividend at the rate of 8 per cent. per annum, less income-tax, on the preference stock of the Company, and of 3 per cent. per annum, free of income-tax, on its ordinary stock, payable on and after the 7th prox., leaving £462 to be carried to the reserve fund. The revenue account showed that the receipts for messages during the half year had been £1,786, and the expenses £1,644, leaving the net receipts at £142; and the account due from Her Majesty's Government under the guarantee was £3,458, that being the amount required to make up a minimum surplus for appropriation of £3,600.

The CHAIRMAN, in moving the adoption of the report and the accounts, said that the slight falling off in the receipts during the past half year was attributable to the adoption of the word tariff. This had brought in an addition to the number of messages transmitted over their lines, but not to an extent sufficient to recoup them for the diminution in the charges. In the current half year, however, he hoped there would be better returns, and, in fact, at the present moment they were increasing in such a promising manner that he thought in the ensuing half year that they would not have to call on the Government for such a large contribution for guarantee.

The Hon. ASHLEY PONSONBY seconded the motion, and

The CHAIRMAN, in reply to questions, stated that the guarantee would last for nearly two years longer, but when it ceased they would not be in a position to pay 3 per cent. on the ordinary stock.

The motion was then carried unanimously, and the dividends proposed having been declared, the meeting closed in the usual manner.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY (LIMITED).

Report of the directors to be submitted to the shareholders at the seventeenth ordinary meeting to be held on Tuesday, the 1st day of March, 1881, at 1 o'clock precisely. The directors have the pleasure to submit their seventeenth annual report to the shareholders. The accounts for the year show a net profit of £93,673 10s. 10d. after charging the interest on the debentures. To this sum must be added £68,701 9s. 3d. brought forward from last year, making a total of £167,375 0s. 1d. From this amount is deducted the interim dividend of 5 per cent., paid July 20, 1880, amounting to £22,410, leaving £144,965 0s. 1d. to be dealt with. Of this sum the directors propose to distribute a dividend of 15 per cent. or £67,230, being at the rate of £1 16s. per share, and making, with the amount already paid, a total dividend for the year of £2 8s. per share in cash, free of income tax, leaving £77,735 0s. 1d. to be carried forward to the next account. The operations carried out during the year 1880 have been as follows:—The Eastern Extension Telegraph Company's duplicate Australian cable, alluded to in the last annual report, was finally completed in the month of January. A cable, 108 miles in length, connecting the Northern and Middle Islands of New Zealand, was laid for the New Zealand Government in the month of February. A cable between the Island of Luzon (Manilla), and Hong-Kong, 299 miles in length (for which a concession was obtained from the Spanish Government in February, 1879), was completed in the month of April last, and has since been transferred to the Eastern Extension Telegraph Company. The deep sea portion of the Anglo-American Telegraph Company's Atlantic cable of 1866 has been renewed. This work was successfully carried out with the steamships "Scotia" and "Seine" during the month of August. Subsequently a multiple cable, 209 miles in length, was laid for the same company between Newfoundland, St. Pierre, and Sydney, Cape Breton. In the month of September a cable was laid for the Great Northern Telegraph Company of Copenhagen, connecting Newbiggen, on the East Coast of England, with Arendal, in Norway; and Arendal, with Marstand, on the Coast of Sweden—the total length being 518 miles. Other lengths of cable have been made for various companies, bringing the total amount manufactured during the year to 3,453 miles. The erection of permanent stations for the Eastern and South African Telegraph Company's Line, and the connection of the underground land lines with them, in accordance with the terms of the contract, are still in progress. The factories at Wharf Road and East Greenwich, together with the company's steamships, are in thoroughly efficient working order. The retiring directors are Sir Daniel Gooch, Bart., and Sir Thomas Fairbairn, Bart., who, being eligible, offer themselves for re-election. It will necessary for the meeting to appoint auditors for the ensuing year. Mr. John Gane and Mr. James Glegg (of the firm of Messrs. Quilter, Ball, and Co.), who retire, offer themselves for re-election.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES FEB. 23.		BUSINESS DONE WEEK ENDING FEB. 23. Highest.		Lowest.	
Anglo-American	58¾	59		59¼		58¾
Do. Preferred	86¾,	87		87¾		87
Do. Deferred	30¾,	31		31¾		30¾
Brazil Submarine	9 15-16,	10 1-16		10¼		9 15-16
Cuba	8¾,	9¼		9		9
Do. Preference	16¼,	¾		16¼		16¼
Direct Spanish	3¼,	¾		—		—
Do. Preference	12¾,	13¼		13		13
Direct United States Cable	10¼,	11¼		11¼		10¾
Eastern Telegraph	9¼,	¼		9 11-16		9¼
Do. 6 per Cent. Preference	12¼,	¼		12¾		12¾
Do. 5 per Cent. Debentures, 1899	101,	104		102		102
Eastern Extension	10,	¼		10¼		10
German Union	9¾,	10¼		—		—
Globe Telegraph and Trust Company	6 7-16,	9-16		6 9-16		6¾
Do. Preference	12,	¼		12⅜		12
Great Northern	10¾,	11¼		11		10¾
Indo-European	26½,	27½		—		—
Mediterranean Extension	2½,	3		3		2 15-16
Do. Preference	10¾,	11¼		—		—
Reuter's	10¾,	11¼		—		—
Submarine	280,	300		—		—
West India and Panama	1 9-16,	11-16		1⅛		1⅛
Do. 1st Preference	6¾	¾		6⅞		6¾
Western Brazilian	7 7-16,	9-16		7 15-16		7⅛
West. Union 7 per Cent. 1st Mortgage	122,	127		—		—
Do. 6 per Cent. Sterling Bonds	104,	107		—		—

ADDRESSES.

W. T. GLOVER and Co., Insulated Wire Manu- facturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 6, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

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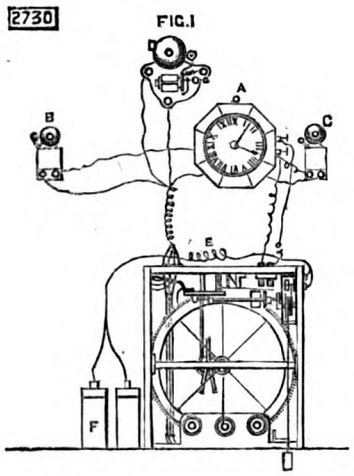
ABSTRACTS OF SPECIFICATIONS.

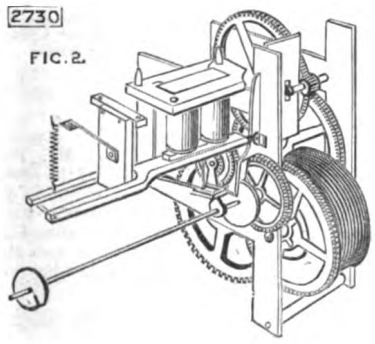
We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts—ED. E.]

2730. IMPROVEMENTS IN AUTOMATIC ELECTRIC TIME SIGNALLING APPARATUS, *J. Wetter.—Dated 3rd July*, 1880.—*(A communication from W. H. Shuey.)* 1*s.*

This invention consists in the combination with a timepiece provided with mechanism for breaking an electric circuit at any regular intervals of time of a motor actuated by spring, weight, water, or other power; a wheel furnished with stop pins corresponding in number to the number of minutes in twenty-four hours, this wheel being revolved by the motor; a circuit-closing device connected with the signalling devices and adapted to close the circuit at any moment of time indicated on the wheel, the stop-pin corresponding to the time of sounding, the signal being withdrawn



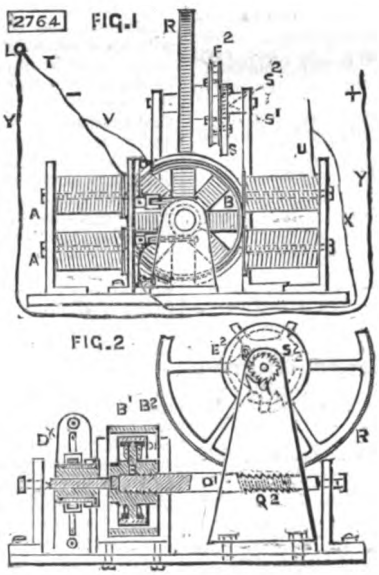
to allow of the automatic closing of the circuit; an armature connected at one end with the circuit closes, and electro-magnets located in the circuit embracing the time mechanism and adapted to regulate the movement of the stop-pin wheel and cause the motor connected therewith to impart an intermittent rotatory movement thereto, and move it through a space equal to the distance



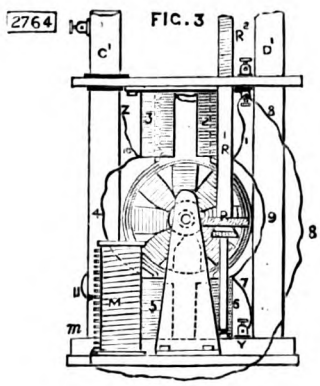
between any two adjacent stop-pins, showing each movement of time as indicated by the time mechanism. Fig. 1 represents the clock A, with bell B, which rings three minutes before a train goes east, bell C, which rings three minutes before a train goes west, and bell D, which rings at the starting time of all trains; E is the signalling apparatus, and F the battery. Fig. 2 gives some details of the signalling apparatus.

2764. IMPROVMENTS IN AND CONNECTED WITH ELECTRIC LAMPS, *G. G. André.—Dated 6th July*, 1880. 8*d.*

In this motor the winding and commutators are doubled, so as to get two currents in opposite directions, and cause the armature ring to revolve in the direction of the predominating current, and from this arrange for the adjustment of the carbons. Fig. 1 is a front elevation, Fig. 2 a side elevation of this motor. The electro-magnet cores A are when the motor is to be used with a lamp wound with thick wire. Outside these coils, but in the same direction, is a series of coils of thin wires to form a shunt resistance. The armature B consists of a central soft iron boss with a number of radial arms and a thin soft iron rim, the arms being wound with wire of suitable thickness, the outgoing end of the coils on one arm and the ingoing end of the coils on the next being brought down to the commutator



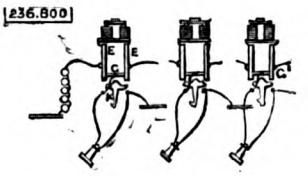
C. The brushes D press on C at the points corresponding with the poles of the free magnets. If the motor is used for other purposes, modifications are made, such as widening the boss and winding with different wire. The apparatus for the adjustment of the carbons will be seen from Fig. 3, showing the motor affixed to the bottom part of the lamp. Resistances are so arranged as to form a Wheatstone bridge arrangement; thus, one branch is composed



of the wires on the cores 2, 3, 5, and 6, another by a thin wire below the peg cap on M, the third by the arc, and the fourth by the thin wire from M to 2. An increase in arc resistance causes flow of current in one direction, a decrease causes a flow in the opposite; the motor thus keeps the resistance constant by varying the length of arc. The inventor claims this direct action of the motor, the combination forming motor, the method adopted for cutting a lamp out of circuit, &c.

236800. APPARATUS FOR TELEPHONE LINES, *Ezra T. Gilliland, Cincinnati, Ohio, assignor to American Bell Telephone Company, Boston, Mass.—Filed December 12th*, 1878.

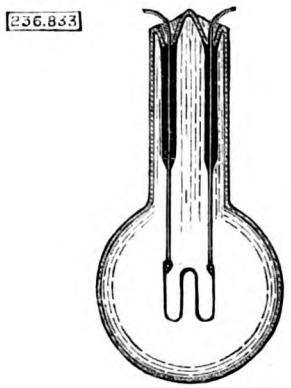
Brief.—When the telephone is on its hook the line is closed through the bell and the telephone is cut out; but the telephone may be connected with the line on either side by removing it from the hook and moving the hook lever to one side or the other, as desired. *Claim.*—(1) The double gravity switch K, combined with the main electric line, the telephone line, and the signal apparatus, substantially as described, for the purpose specified. (2) The combination in a telephone line with the branches on opposite sides of an intermediate station, of a double switch, substantially as described, operated by the weight of a telephone to disconnect either of said branches, as set forth. (3) The combination of the double switch K with the springs E E of the signal apparatus, sub-



stantially as described, for the purpose specified. (4) The combination of the double switch K with the springs E E and connecting bar G of the signal apparatus, substantially as described, for the purpose specified. (5) The double switch K, combined with the signal apparatus, the main electric line, and the telephone line, and adapted to be automatically disconnected from either circuit by weight of a telephone, substantially as described, for the purpose described. (6) An automatic switch comprising, in combination with line-contact pieces and a conductor for establishing a ground connection, as required, a shifting telephone support, as explained, for connecting as desired the line on either side of said contact pieces with the ground conductor, and being movable under the weight of the telephone to restore the line circuit, substantially as set forth. (7) The combination of the switch having the arms, the springs EE, connecting with a local circuit, the plates G^1, both normally connected with the main circuit, and the spring or a bar connected with a telephone circuit, substantially as described, for the purpose specified.

236833. ELECTRIC LAMP, *Joseph V. Nichols, Brooklyn, assignor to the United States Electric Lighting Company, New York, N.Y.—Filed October 18th*, 1880.

Brief.—Copper wires are used to support the carbon strips. These wires are sealed in a metallo-vitreous cement. *Claim.*—(1) The combination, in an electric lamp, of a glass globe enclosing an incandescent conductor in a vacuum with conducting wires connected with said conductor, and metallo-vitreous cement interposed between the



glass of the globe and the conducting wires, and united to both by fusion, substantially as described. (2) In an electric lamp, a glass globe enclosing the incandescent or light-giving part in a vacuum, in combination with conducting wires of copper or other metal of high conductivity and metallo-vitreous cement interposed between the glass of the globe and the conducting wires, and united to both by fusion, substantially as described.

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ORIENTAL TELEPHONE COMPANY

(LIMITED)

(BELL AND EDISON'S SYSTEM.)

Incorporated under the Companies' Acts, 1862 to 1880.

CAPITAL, £300,000, IN 300,000 SHARES OF £1 EACH.

100,000 of these Shares are to be issued in part payment for the rights and property purchased, and will, under the agreement with the Vendors, only carry such right to participate in profits as explained in the body of the Prospectus. 50,000 of the remaining Shares have been already applied for, and will be allotted in full, and the balance of 150,000 is now offered for subscription at par.

Payment as follows:---2s. 6d. on Application, 2s. 6d. on Allotment, and 5s. on the 2nd day of May, 1881.

IT IS NOT EXPECTED THAT ANY FURTHER CALLS WILL BE REQUIRED.

DIRECTORS.

JOHN PENDER, Esq., M.P., Chairman Eastern Telegraph Company (Limited), 18, Arlington-street, Piccadilly, W., CHAIRMAN.

Sir JULIUS VOGEL, K.C.M.B., late Premier of New Zealand, 135, Cromwell-road, S.W.

Sir ALEXANDER ARMSTRONG, K.C.B., LL.D., F.R.S., &c., &c., late Director-General, R.N., The Albany, Piccadilly, W.

Sir WILLIAM THOMSON, LL.D., F.R.S., M.I.C.E., Professor of Natural Philosophy in the University of Glasgow, Consulting Electrician and Ex-officio Member of the Board of Directors.

PATRICK CARNEGY, Esq., C.I.E., late Commissioner Land Revenue, Oude, India, Ellery Court, Upper Norwood.

DILLWYN PARRISH, Esq., a Director of the United Telephone Company (Limited), Southborough Lodge, Bickley, Kent.

*ALEXANDER GRAHAM BELL, Esq.

*THOMAS ELVA EDISON, Esq.

*JOHN P. BIGELOW, Esq., late Fiscal Agent of the U.S. Treasury Department, 133, Cromwell-road, S.W.

*WILLIAM W. CARGILL, Esq., late Director of Railways and Telegraphs, Japan, Lancaster Lodge, Campden-hill, W.

*Col. GOURAUD, a Director of the United Telephone Company (Limited), and a Director of the Edison Telephone Company of London (Limited), The Woodlands, Beulah-hill, Surrey.

*The Honble. GARDINER G. HUBBARD, Deputy-Chairman of the International Bell Telephone Company (Limited), and a Director of the American Bell Telephone Company, 36, Coleman-street, E.C.

(With power to add to their number.)

The gentlemen marked thus * (being interested as Vendors) will not join the Board until after the completion of the purchase.

BANKERS.

Messrs. SMITH, PAYNE, and SMITHS, 1, Lombard-street, E.C.

SOLICITORS IN LONDON.

Messrs. RENSHAW, 2, Suffolk-lane, London, E.C.

SOLICITORS IN CALCUTTA.

Messrs. SANDERSON and Co.

BROKERS.

Messrs. ARTHUR ANDERSON and Co., 30, Throgmorton-street, London, E.C.

AUDITORS.

Messrs. DELOITTE, DEVER, GRIFFITHS, and Co., 4, Lothbury, E.C.

GENERAL MANAGER.

JAMES M. ORMES, Esq., late General Manager Southern Bell Telephone and Telegraph Company of the United States.

SECRETARY.

WILLIAM G. HALL, Esq.

OFFICES IN LONDON.

6, LOMBARD-STREET, E.C.

PROSPECTUS.

This Company is formed to provide Telephonic communication by exchanges, private lines, and otherwise in India, Ceylon, the Straits Settlements, Java, China, Japan, South Africa, Australia, and New Zealand, Egypt, Turkey, Greece, Malta, and the Hawaian Islands, and elsewhere, wherever the Company may acquire rights.

The introduction of the Telephone into the East was commenced by the Vendors several months ago, when competent managers, with skilled men, were sent out to many of the countries named.

A sufficient equipment for three hundred stations was sent to India, together with skilled electricians, engineers, and line-men, to establish exchanges in Bombay, Calcutta, and Madras, and equipment for other cities is now on the way.

From the reports of the Manager in India it appears that India will be a fruitful field for the Telephone, and that, when it is fairly introduced, there will be a considerable number of Telephone Exchanges in operation. He writes that he is promised a sufficient number of subscribers to establish exchanges in several of the large cities, and that no difficulty will be found in raising the funds required for establishing local companies. He believes that private line business promises to be much larger than was expected, and he writes requesting that an independent staff to carry on this business be sent out at once. The Telegraph is only used in India for purely local communication, to a limited extent, as there are comparatively few telegraph offices, and these are generally far removed from the customers. The Telephone will supply this want. He hopes that arrangements will be made with the Telegraph authorities by which the Subscribers may be connected directly with the Telegraph through the Telephonic Exchange. The various agents already sent out have been instructed to disclaim any intention of performing Telegraphic business wherever it clashes with Government or other vested interests. It is believed that the Telephone will, at an early date, become a valuable ally to the Telegraph system, and thus increase the traffic of that system. The natives use the Telegraph little on account of the difficulty of translating from their own tongues into the Telegraphic code, and retranslating the same. The Telephone is of its nature polyglot, and all natives can communicate by it in their own vernaculars. During the hot and the rainy seasons such great difficulty is experienced in personal communication, and so much inconvenience and expense are caused by the necessary delay in sending native messengers, that it may fairly be expected that the natives and Europeans will readily and extensively avail themselves of Telephonic communication.

A concession from the Khedive to establish exchanges in Egypt, which will belong to the Company, has been already obtained. A sufficient equipment for forming exchanges in Alexandria and Cairo has been sent out, with a staff of officers. Steps will be immediately taken to form a local company in Egypt subordinate to this Company.

The General Manager of the Anglo-Indian Telephone Company, Limited, the business of which Company is to be absorbed by the present Company, has been sent to Singapore, where he formerly resided, and a full equipment is now on the way to that settlement.

The parties engaged in these enterprises have united with the other Directors in forming this Company, with a view to carrying on the business thus commenced on a more comprehensive scale.

The Board of Direction includes several gentlemen who have been connected with the management of the principal Telephone Companies since their formation, notably the American Bell Telephone Company, the United Telephone Company, Limited, the International Bell Telephone Company, the Edison Telephone Company of London, Limited, and the Edison Telephone Company of Europe, Limited.

All telephone privileges, in the nature of letters patent, or concessions for the use of Telephones that Mr. Alex. Graham Bell and Mr. Thomas Alva Edison have acquired, or are entitled to acquire, in any of the countries above-named, in respect of their inventions, will, with the exception of Mr. Edison's patents for Australia, be transferred to this Company, together with the goodwill of the businesses, in so far as at present organised in any of these countries. In Australia and Japan, Mr. Edison has already granted certain rights to others, reserving a royalty; this royalty will be transferred to the Company.

The purchase-money for the rights and property transferred to the Company has been fixed at the sum of £150,000, of which £50,000 (part thereof) is payable in cash within two months after allotment of the Shares of the Company, and £100,000 payable in fully paid-up Shares of £1 each. The Vendors, however, have agreed that during the first five years after the incorporation of the Company, their Shares shall only carry a right to participate in the profits after a Dividend at the rate of 6 per cent. per annum shall have been paid on the other shares, and if in any of such five years Dividends of 6 per cent. per annum on such Shares are not paid, the deficiency shall be made up out of the profits in future years, in priority to the rights of the holders of the Vendors' Shares to participate therein.

To illustrate the probable profit that may be expected, Mr. Hubbard, one of the Directors of the American Bell Telephone Company, which was organised in July, 1878, is able to state that, with a capital of £30,000, since increased to £1,200,000, of which about £300,000 has been paid up, it now pays Dividends at the rate of 7 per cent. per annum on its total capital of £1,200,000, equal to 28 per cent. on its paid-up capital. Also

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that many of the local American Telephone Companies subordinate to the American Bell Company have met with like success. The Shares of the United Telephone Company, Limited, formed for the purpose of working the Bell and Edison Telephone inventions in Great Britain, with an actual capital of £400,000, in Shares of £5 each, which were issued at par in London last June, have been largely sold and purchased at a premium of 30 to 40 per cent.

The advantages of the Telephone are so obvious, and its use is becoming so general, that it is difficult to place a limit on its ultimate extension, but it is estimated that within a short time sixty to seventy Telephone Exchanges can be opened in the countries named. When only fifty Exchanges are in operation, with an average of 200 subscribers, or 10,000 subscribers in all, the receipts at £20 per annum each would amount to £200,000 a year.

A further source of income is anticipated from the leasing of private lines, for which a large demand is expected in a considerable portion of the Company's field of operations.

The Company relies for its success on the superiority of its instruments; the identification with it of Messrs. Bell and Edison, and other gentlemen who have already been instrumental in introducing the telephone successfully in various countries; the possession of the best available technical knowledge and skill; the plan by which the co-operation of leading men in each district will be secured, and in being the first to occupy and organise business in a most populous extensive territory where the Telephone has not hitherto been generally introduced.

The only agreements that have been entered into by or on behalf of the Company, except certain agreements with *employés* in subordinate positions, are:—

An agreement dated the 25th Jan., 1881, between Alexander Graham Bell of the first part, Thomas Alva Edison of the second part, the Oriental Bell Telephone Company of the third part, the Anglo-Indian Telephone Company, Limited, of the fourth part, and Samuel Insull, Trustee for the Oriental Telephone Company, Limited, of the fifth part; and a supplemental agreement, dated the 17th day of February, 1881, and made between the above-named parties of the first four parts, of again the first four parts and the Company of the fifth part.

An Agreement, dated the 27th September, 1880, between Clement D. Leggatt, of the one part, and the Oriental Bell Telephone Company and George E. Gouraud, of the other part. An Agreement, dated the 25th day of September, 1880, between Edwin D. Leon, of the one part, and Gardiner G. Hubbard, Alexander Graham Bell, John P. Bigelow, and James M. Ormes, of the other part. An Agreement, dated the 14th day of October, 1880, between the Anglo-Indian Telephone Company, Limited, on the one part, and Mr. W. L. Hill, of the other part; and an Agreement, of the same date, between the same Company and Mr. Henry Frank Wilkes, of the other part. The above contracts, with the exception of that of the 25th January, 1881, relate to the engagements of the parties respectively.

These Agreements, together with the Memorandum and Articles of Association, can be seen at the Offices of the Company.

Prospectuses and Forms of Application for Shares can be obtained from the Offices of the Company, or from the Bankers, Solicitors, or Brokers.

In the event of no Allotment being made amounts paid on Application for Shares will be returned in full on production of Bankers' receipt.

Application for Shares may be made on the forms accompanying the Prospectus, or by letter in the following terms, forwarded to the Bankers of the Company, Messrs. Smith, Payne, and Smiths, 1, Lombard-street, London, E.C.

TO THE DIRECTORS OF THE ORIENTAL TELEPHONE COMPANY (Limited).

Gentlemen,—Please allot me Shares in the above Company, for which cheque for £ , first instalment on account thereof, is enclosed.

Signature.....

Address .....

Date .....

THE FITZ-GERALD ELECTRIC LIGHT and POWER COMPANY (Limited).—Capital, £100,000, in Shares of £1 each. First issue of 5,000 Shares. For full Particulars, Prospectuses, and Applications for Shares, apply, in person, or by letter, to the SECRETARY, 13, York-buildings, Adelphi, W.C.

TELEGRAPH CONSTRUCTION and MAINTENANCE COMPANY (Limited).—NOTICE IS HEREBY GIVEN, that the TRANSFER BOOKS of the Company will be CLOSED from the 21st inst. to the 1st proximo, both days inclusive, preparatory to the payment of Dividend to all Shareholders on the Register on the 21st inst.

By order, W. SHUTER, Secretary.

38, Old Broad-street, London, E.C., Feb. 18, 1881.

TELEGRAPH CONSTRUCTION and MAINTENANCE COMPANY (Limited).

Notice is hereby given that the SEVENTEENTH ORDINARY MEETING of the Shareholders of the TELEGRAPH CONSTRUCTION and MAINTENANCE COMPANY (Limited) will be held at the CANNON-STREET HOTEL, E.C., on TUESDAY, the 1st day of March, 1881, at 1 o'clock in the afternoon precisely, to receive a Report from the Directors, and for the ordinary business of the Company.

The Registers of Transfers will be closed from the 21st instant to the 1st Marc 1881, both inclusive.

By order, W. SHUTER, Secretary.

38, Old Broad-street, E.C., February 21st, 1881.

BRITISH ELECTRIC LIGHT COMPANY (Limited).—NOTICE OF REMOVAL.—In consequence of their rapidly-increasing business, this Company have now REMOVED to their new enlarged premises, combining offices, show-rooms, and experimental workshops. Address, Heddon-street, Regent-street, London, W.

THE LONDON PLATINO BRAZILIAN TELEGRAPH COMPANY (Limited) (River Plate and Brazil Telegraph Company). Notice is hereby given that the HALF-YEARLY COUPONS, which fall due on the 1st March, 1881, of £100,000 Seven per Centum Debentures of the River Plate and Brazil Telegraph Company will be PAID by Messrs. GLYN, MILLS, CURRIE, and Co., bankers, at 67, Lombard-street, in the City of London, on and after the 1st day of March, 1881. The coupons must be left with Messrs. GLYN, MILLS, CURRIE, and Co., for examination three clear days before the same can be paid.

By order, WILLIAM PAYTON, Secretary.

No. 66, Old Broad-street, London, E.C., 17th February, 1881.

THE "JAMIN" PATENT ELECTRIC LIGHT,
COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.
Capital 8,000,000 francs.
Proprietors of the Gramme Patent Machine for alternate currents.
J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

ELECTRIC LIGHT.—Advertiser, an Englishman, who has had great experience in public and private lighting, and illuminations abroad, is OPEN to TREAT with inventors and companies for the introduction and working of their patents or systems in Italy. Address,

JAMES SHEPHERD,
66, Corso Porta Romana, Milan.

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.

Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

Letters of Credit and Circular Notes issued.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

Southampton-buildings, Chancery-lane

NOTICE OF REMOVAL.

EDWARD PATERSON,

TELEGRAPH AND ELECTRICAL ENGINEER,

3, BEDFORD COURT, COVENT GARDEN, W.C.,

Will on and after the 1st May, 1880, REMOVE to

76, LITTLE BRITAIN, ALDERSGATE STREET, E.C

The Gower-Bell Loud Speaking Telephone.

TELEPHONE LINES ERECTED and MAINTAINED.

EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.

Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

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HARBURG AND VIENNA INDIA RUBBER WORKS,

HARBURG-ON-ELBE.

London Office: 11/14, Tower Chambers, London Wall and Moorgate, E.C.

MANUFACTURERS OF

GUTTA PERCHA INSULATED TELEGRAPH WIRE.

Also Covered with Silk or Cotton, Taped or Braided.

ZANNI

& CO.,

47, HOLBORN VIADUCT, E.C.,

(OPPOSITE THE CITY TEMPLE),

MANUFACTURERS OF ZANNI'S PATENT DYNAMO-ELECTRIC MACHINE,

The Cheapest in the Market.

MAGNETIC BELLS.—No Battery required. Satisfactory working guaranteed for five years.
ELECTRIC BELLS of every description for House and Ships' Use.

Burglar Alarms. Pear & Button Pushes. Insulated Wire. Indicators. Fire Alarms.

Estimates given for Fitting Up Houses, &c., Complete.

ILLUSTRATED PRICE LIST ON APPLICATION.

Models Made. Experimental Work done. All repairs promptly executed on the premises.

Silk Covered Wire. Binding Screws. Double Covered Wire for Indoor or Outdoor Use.

ELLIOTT BROTHERS,

449, STRAND,

Manufactory—101 and 102, ST. MARTIN'S LANE, W.C.

MAKERS OF ALL KINDS OF

Electrical Test, Mathematical, Physical, and other

SCIENTIFIC INSTRUMENTS.

J. S. STARNES AND SONS, ENGINEERS,

WHOLESALE MANUFACTURERS AND CONTRACTORS.

TELEGRAPH SHIP FURNISHERS, FOR ENGINEERS', CARPENTERS', STEWARDS', DECK STORES &c

Engine Room Reply Telegraphs.	Ships' Pumps and Closets.	Braziers and Coppersmiths.
Patent Ventilators.	Side Scuttles and General Brass and	Ships' Cooking Hearths.
Sea Water Distillers.	Copper Work.	Lamp Makers.

IMPROVED TUG and LAUNCH ENGINES and BOILERS and GENERAL REPAIRS.

13, Broad Street, Ratcliff, E., and 4, New London Street, Fenchurch Street, E.C.

NEWALL'S PATENT LIGHTNING CONDUCTORS.

Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'S PATENT COPPER-ROPE LIGHTNING CONDUCTOR,

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offere to the public. It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.

SOLE PATENTEES OF UNTWISTED WIRE ROPE.

Manufacturers of Iron and Steel Ropes for Colliery and Railway purposes. Rigging Ropes, Guide Ropes, &c

Gilt and Silver Cord for Hanging Pictures. Iron, Steel, and Copper Cord for Clock and Sash Lines, &c.

R. S. NEWALL & CO., LONDON, 130, STRAND, W.C.

LIVERPOOL—36, Waterloo Road. GLASGOW—68, Anderston Quay. Manufactory—GATESHEAD-ON-TYNE.

TO AMATEURS.—JOHNSTON and COMPANY'S NEW PRICE LIST contains everything necessary for EXPERIMENTS with Electricity, Electrotyping, Plating, &c., and will be sent post free on application.—121, Wardour-street, London, W.

PARIS ELECTRIC EXHIBITION.—An English Gentleman, having Office in Paris and good connections in the principal Capitals of Europe, is willing to REPRESENT PATENTEES or others at the forthcoming Exhibition. Principals only address HORACE SANDARS, 46, Rue St. Georges, Paris.

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SLIP

ELECTRO-METALLURGY.—A series of articles is appearing in the *Scientific American* on the above subject. We hope to reproduce them as soon as our space will permit.

THE TELEPHONE AT NEWPORT (MONMOUTHSHIRE).—We hear that communication between Cardiff and Newport by means of the telephone is nearly complete, and will be shortly opened.

THE TELEGRAPH IN ARGYLLSHIRE.—A petition has been sent to the Postmaster-General praying for the extension of the telegraph wires from Bridge of Lussa to Lochbuy, a distance of six miles.

SUIT DISMISSED.—The Anglo-American Telegraph Company notify that the action, "Thorne v. the Anglo-American Telegraph Company," having been dismissed, the suspended dividend is now being paid.

FEMALE TELEGRAPHISTS IN PARIS.—The day clerks at the Place de la Bourse have been replaced by women. Only experienced male clerks, acquainted with the night duties and Press service, have been retained at that office.

AMSTERDAM.—The Central Telegraph Office at this place is lighted by the Von Hefner-Alteneck system of electric lighting. The result is said to be very satisfactory, especially as regards the temperature and wholesomeness of the room.

ELECTRIC LIGHT AT NORWICH.—With reference to our note of last week we learn that Mr. Crompton's tender has been accepted for the lighting of the Market Place and St. Andrew's Hall at Norwich. The experiment is to last for thirteen weeks.

A NEW TELEPHONE.—Some satisfactory experiments were lately carried out at the School of Military Engineering, Chatham, with a new telephone, the invention of Mr. F. H. Hodd, chief inspector of machinery attached to the Medway Steam Reserve.

SUNDERLAND AND TELEPHONE WIRES.—The Corporation have passed a resolution instructing the Telephone Company to take down their posts and wires, or pay a certain rent for them. Hitherto they have been allowed to lay wires over the streets free.

GAS SHARES.—Two hundred of the £25 "A" shares of the Southampton Gas Company lately realised £32 10s. to £32 15s. per share. At a similar sale in October last they fetched from £32 15s. to £33 5s. Shareholders may take courage; there is a large margin yet.

SOCIETY OF TELEGRAPH ENGINEERS AND THE PARIS EXHIBITION.—The Treasury having declined to send a Commissioner to Paris, the Society of Telegraph Engineers are about to form a Committee to organise some arrangement that will meet the requirements of British exhibitors.

SUCCESS OF THE ELECTRIC LIGHT.—At the last meeting of the Swansea Town Council, a most favourable report was received on the success of the Bristol experiments; one of the members also stated that its introduction to some works at Landore had reduced the cost of illumination by one fourth.

ELECTRIC LIGHTING EXTRAORDINARY.—The Brush Electric Light Company were able to accomplish during the recent long sitting in the House of Commons a feat hitherto without a parallel in the annals of electric lighting. They lighted Westminster Palace-yard for sixteen hours with a single carbon.

PRICES.—The prices of gutta percha as quoted are:—Per lb., for genuine 4d. to 3s. 3d., and for reboiled 3d. to 1s. 3d.; and for india rubber, per lb., for Para, fine, 3s. 4d., negrohead 2s. 3d., Central American 1s. 10d. to 2s. 4d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d.

TELEPHONE WIRES.—The Edinburgh Town Council, upon application for permission to erect a pole for telephone wires on the roof of the City Chambers, decided to delay granting the permission, because the telephone companies had paid no attention to the Town Council's request that they should be furnished with a plan of the wires laid throughout the city.

THE CUBA SUBMARINE TELEGRAPH COMPANY.—The number of messages passing over the lines of this company during the month of February was 2,752, estimated to produce £2,000 against 2,849 messages, producing £3,140 in the corresponding month (29 days) of last year. The traffic receipts for the month of December, estimated at £2,300, realised £2,494.

A NICE QUESTION FOR THE AMERICAN COURTS.—The land lines in America had agreements with the Atlantic cable companies. The land lines amalgamate. The moving spirit, Jay Gould, makes an agreement with a new cable company (his own) exactly similar to those existing between the amalgamated companies and the cable companies. What is the value of Jay Gould's agreement?

THE EDISON TELEPHONE COMPANY (LIMITED).—In the Court of Appeal, Lincoln's Inn, on Saturday, an appeal on behalf of Mr. Edison and others against an order made by the Master of the Rolls for a winding-up of this company was ordered to stand over generally, as negotiations were proceeding for a settlement, with liberty to apply if the negotiations should come to nothing.

THE PRICE OF GAS.—The good folk of Penistone have begun to kick against 5s. per 1,000 feet as the price of this illuminant. At a recent general meeting of ratepayers and consumers statistics were brought forward showing that 3s. per 1,000 feet would be a fair price and leave a good profit. If these figures be correct we can only wonder that the Penistonites did not kick long ago.

LEGAL.—A controversy between Graham Bell and David Brooks, an electrician of Philadelphia, with regard to the discovery of the use of a return wire on a telephone circuit, to prevent the noises of induction, has just been settled. The award has been given in favour of Mr. Brooks, who made the discovery in July, 1877, whereas Professor Bell did not make it until the end of August of that year.

TELEGRAPHIC REFORM.—In support of the suggested reform in the charges for telegrams a German correspondent writes that the system of charging a halfpenny per word has been in force in Germany for several years; and that whereas formerly under the uniform charge of 1s. per message the department was carried on at a loss, at the present time a profit is made on the telegrams.

PROFESSOR TYNDALL AND THE PHOTOPHONE.—*L'Électricité* has received "a very important letter from the celebrated successor of Faraday concerning his (Professor Tyndall's) recent splendid series of experiments. 'They prove,' says *L'Électricite*, 'that the phenomena hitherto erroneously described as *photophonic* are due not to the direct action of light, but to the heat rays conveyed by the light.'"

TELEPHONE AND FIRES.—At Burnley we hear that telephonic communication between the fire station and the outlying districts has been begun, Mr. J. Sharples, of Preston, being the contractor. From Bolton also we learn that since a large fire, which occurred recently in a mill, telephonic com-

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munication has been established between the fire station and several mills. The work was done by the Telephone Exchange Company of Bolton.

TELEPHONIC SERMONS.—From Edinburgh we hear of an invalid member of a Presbyterian congregation who, unable to attend service, has by means of the telephone, done what Mahomet could not do to the mountain, viz., brought the services to him. Sounding chambers have been placed in the pulpit, and in the choir gallery, and by this means the thunders of the minister, the singing of the choir, and indeed any coughing or like disturbance that may occur is faithfully transmitted to the invalid. Clergymen can no longer judge of the size of their congregations by those visibly present, and may take heart of grace if they see but one little charity boy before them.

ELECTRIC LIGHT AT BRIGHTON.—Further experiments with the electric light have been made in the illumination of the Marine Parade. The four lamps hitherto have been placed at intervals of about 130 feet; but the Gas Committee have decided to increase the intervals and to place the lamps at varying distances, from 95 to 110 yards apart, so as to determine whether fewer lamps than at first supposed will not be sufficient for the purpose. This change will meet the only objection, excepting that of expense, as yet brought against the light, namely, of being too intense; whilst it is believed that, when a fair comparison is made, the extra expense of electricity over gas will be inconsiderable, if any.

EMBARKATION OF THE TELEGRAPH TRAIN.—A complete unit of the Royal Engineers Telegraph Train embarked in the ss. transport *France*, which sailed the other day for Natal. Two cable waggons were sent out with them, each carrying six reels of telegraph wire under the body of the carriage. As each reel contains half a mile of cable, a single waggon could provide a telegraph three miles long. In addition to this, however, a reserve of wire was taken sufficient for fifty miles of line. In operations in the field it is stated that these troops can take up and lay down a wire as fast as an army advances or retires. The present war is a good instance of the celerity with which this department works nowadays.

SOCIETY OF ARTS.—The next series of Cantor Lectures, to be delivered before the Society of Arts, will be by Professor W. G. Adams, F.R.S., his subject being "The Scientific Principles involved in Electric Lighting." The course commences on Monday, the 7th March, and will continue on the three following Mondays, ending March 28th. The first two lectures will be mainly introductory, and will deal with such subjects as the production, regulation, and measurement of electric currents, and the action of magneto-electric and dynamo-electric machines. In the third and fourth lectures it is hoped to show a large number of illustrations of the various systems of electric lighting. The new incandescent lights of Swan and Lane Fox will be exhibited at the fourth lecture.

THE QUESTION OF LIGHTING, &C., AT THE EXHIBITION.—At a meeting of the Technical Committee of the Exhibition, on the 28th of February, M. G. Berger stated that the illumination of the Palace and its annexes would be unique, as all the systems, both French and foreign, would be employed at the same time. The motive force required would be about 800 horse-power, and more than 50 kilometres of wire would have to be laid down. As regards exhibits, the exhibition will be divided into six groups, comprising 16 classes; the groups are as follows:—I. Production of Electricity. II. Transmission of Electricity. III. Electrometry. IV. Application of Electricity. V. General Mechanics (in their application to Electrical Industries). VI. Bibliography and History.

TELEGRAPH SERVICE AT IPSWICH.—The Postmaster-General has just replied in the negative to a petition of the inhabitants of Ipswich that the telegraph office should be kept open day and night. From his answer it would appear that the office is open from 7 a.m. to 11 p.m. on week days, and on Sundays from 7 a.m. to 10 a.m., and 5 p.m. to 6 p.m., and in addition there are special arrangements daily, by which the office is kept open from 11 p.m. to 3 a.m. for Press news, during which time the wires can be used for private messages, on payment of the late fee of 1s.; further, the Postmaster-General finds that on an overage only three messages are forwarded per week between 10 p.m. and 11 p.m., and that it is very rare for one to be sent between 11 p.m. and 3 a.m.

INTERNATIONAL ELECTRICAL EXHIBITION.—We are informed that the following gentlemen have been appointed by their respective Governments as Commissioners to the above Exhibition, viz., Germany, Herr Elsässer, Privy Councillor; Belgium, the Count of Oultremont; Austria, Dr. Herman Militzer. Sufficient applications for space have been received to plan out the various departments, and M. Georges Berger, the Commissioner-General of the Exhibition, begs all who intend to exhibit, and have not yet notified their intention, to do so as soon as possible before the 31st of this month. The office of the Commissioner is in the Palais des Champs-Elysées, Porte No. 4, and he himself can be seen on Mondays, Wednesdays, and Fridays, from 3 to 5; the office, however, is open every day from 10 to 5.

POST OFFICE TELEGRAPHS.—From papers lately issued it appears that the gross amount received in respect of the Post Office Telegraph service from 1870 to March 31st, 1880, is £11,592,160 18s. 3d., and the gross amount expended is £9,920,597 9s. 7½d., which leaves, to meet interest on stock created on account of the telegraph service, and the redemption of debt, a balance of £1,671,563 8s. 7½d. The balances have been appropriated as follows:—Amount of interest on stock, £2,835,365 11s. 9d.; applicable to a sinking fund, £53,039 2s. 4d.; while the deficiencies amounted to £1,216,841 5s. 6d. They also show that during the year 1880 the gross amount received was £1,469,795 6s. 6d.; there was a balance to meet interest on stock of £296,508 0s. 2d., and a deficiency of revenue to meet interest on telegraph stock of £29,909 2s. 7d. The capital account now amounts to £10,529,577.

STIRRING THEM UP.—A correspondent writes to the Birmingham *Daily Post* asking why the authorities do not try the electric light in the large station at New-street, pointing out what a comfort it would be to passengers. Speaking of his experience of the light he says:—"During November last I passed through the newly-erected station of the city of Hanover, at three in the morning. Illuminated by electricity, the effect was magical—night had suddenly changed into day. Being a junction and a central station, the comfort to the traveller who has to change is incalculable. The station of the smaller city of Elberfeld, and the stations of many other German towns, have adopted the electric light. Is Birmingham, always in the vanguard of progress, to lag behind in adopting one of the most beneficent inventions of our time?" We thought Birmingham was the home of—well, "progress." Perhaps we were mistaken.

OVERHEAD WIRES.—Slowly but surely public opinion is ripening on this question, and the result cannot for a moment be doubted. Overhead wires on the present system must be abandoned in populous towns. The accounts of the

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general wreck of overhead wires in New York during the January storms will be a warning of no uncertain sound. The fire alarum system had to be abandoned, telegraphy and telephony were at a standstill, the railway lines were blocked with *débris* from the telegraph system, and, worst of all, a large number of serious accidents are reported. New Yorkers have been rather conceited about their intricate network of overhead wires, but the dangers of such a system are now fully recognised, and we should not be surprised to hear of the general adoption of a safer system. Out of about 370 wires of the Western Union Company only two were working, and the damage to the property of the various companies has been estimated at 500,000 dollars.

Glasgow.—The *Proceedings of the Philosophical Society of Glasgow* for 1879-80, just issued, contains the paper of Mr. W. J. Miller on the "Mechanical Transmission of Sound by Wires, and on Simple Forms of Microphone Receivers." The following note has been added to the original paper:—Since reading the paper the author has made some additional experiments upon the mechanical transmission of sound with wires arranged as in some of the recorded experiments, but without any disc or vibrating flat surface at the sounding extremity of the line; and it was found that speaking, singing, and musical sounds could be readily transmitted in this manner. In the case of transmission of speech, the speaker spoke to the wire and close to it; the musical instrument, however, was about twelve feet from the wire. It was also found that the ticking of a watch could be very distinctly heard, the watch simply resting on the wire. From these experiments the author believes that a great part at least of the action of strained wires, as used in buildings for the improvement of the acoustics, is explained by the wires picking up the sounds, and transmitting them to other parts of the building, where their motions either become absorbed or they cease to have much effect upon the air or parts of the building in their vicinity.

An Ingenious Magnetic Toy.—Another American novelty, not only novel but useful, consists of a small cardboard box in which is swung a magnetic needle; over this is fixed a plate of glass, on which is glued a piece of paper marked out in spaces like a clock dial, leaving a hollow space in the centre, on which another piece of paper is glued, with the directions for use printed on it, leaving a small space between the centre and outer piece of paper, so that the needle can be seen through the glass. It is designed for teaching young children, and at the same time amusing them. The subject of the toy under notice is music. A piece of cardboard, with a magnet inserted, cut into points star-shaped, is made to fit the centre piece above described, on which is a black dot; on the star-shaped cardboard are printed the questions to be asked, as, for instance, What is a bar? To obtain the answer, which will be found printed in one of the spaces of the dial, or outer piece of paper, it is necessary to place the point of the cardboard in the centre of the division in which the question is printed on the black dot, when the needle in the inside of the case will be seen (through the glass) to swing round till it stops opposite the answer. The subject of the questions can, of course, be altered at will by the makers of the toy. At present these appear to be confined to history, geography, scripture, and music, whilst conundrums and matrimonial have been laid under contribution. The agents in this country are Messrs. Jacobs and Co., of 179, Aldersgate-street, E.C.

Telegraph Clerks' Grievances.—On Saturday last a deputation from the clerks in the Central Telegraph Department of the General Post Office waited upon the Lord Mayor, M.P., and Mr. Alderman and Sheriff Fowler, M.P., to obtain the support of the citizens and Corporation of London to a memorial which had been presented to the Postmaster-General. After hearing statements from Mr. Coates and Mr. Slingo, who acted as spokesmen, the Lord Mayor said he thought they were in the hands of a gentleman who was disposed to do everything in his power in the matter, and he had great confidence in Mr. Fawcett's doing them every justice. If they had cause for complaint he was sure that, being in the Postmaster-General's hands, he would do everything that was right and fair towards them. In his opinion the services of the telegraph clerks were very important, and they should be placed upon the same footing as other civil servants. He would look carefully into the papers they had given him, and if he saw his way to take any further action in the matter, he would do so. The deputation thanked his lordship, and withdrew.—Meetings have been held all through the country during the last week in support of the agitation, and in many places the Mayors have signed the petitions. At Manchester the female clerks have drawn up a petition for presentation, independently of any others; whilst in London they have presented their petition, which bore 476 signatures. It was announced on Wednesday that the Postmaster-General had requested ten telegraphists to come to see him on the 15th inst., for the purpose of discussing their grievances. The deputation was to consist of four men and two women from the provinces, and two men and two women from London.

International Electrical Exhibition and the Government.—In the House of Commons on Tuesday Sir H. Tyler asked the Secretary to the Treasury whether any, and, if so, what arrangements had been made to afford facilities to meet the requirements of British exhibitors at the forthcoming International Exhibition of Electrical Apparatus at Paris?—Lord F. Cavendish said it was not intended to appoint a Commission for the purposes named. The Government had never yet undertaken the task of affording facilities to British exhibitors at foreign exhibitions of a special character. Past experience in connection with international exhibitions of a general character had shown that there was no kind of expenditure more difficult to keep within bounds. The expenditure incurred had varied between the limits of £28,000 spent in connection with the Exhibition at Vienna and £115,000 spent on that at Paris in 1867. Though the expenditure on exhibitions of a special character would doubtless be of a very much smaller amount it would be equally difficult to control, and if the precedent were once to be set it would be impossible for the Government to refuse equal facilities in the case of the numerous exhibitions of a similar character which would doubtless be held hereafter. In coming to the conclusion that they had done the Government in no way wished to disparage the importance of the proposed Exhibition; but, on the contrary, they recognised its great interest, and the Postmaster-General had been authorised to accept the invitation which had been addressed to him to exhibit specimens of telegraph appliances both past and present. Delegates would also be sent from the Post Office to take part in the Congress of Electricians, which would be held at the same time as the Exhibition. He might add that there was nothing to prevent the formation of a committee to afford facilities to British exhibitors, as was done on the occasion of the Brussels Exhibition and on some others, when the Government took no direct part, and he hoped such a committee might be formed.

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THE TELEPHONIC SYSTEMS OF DR. C. HERZ.*

BY LE COMTE DU MONCEL.

In spite of the recent advances towards perfecting the telephone, we have not as yet an instrument with which to transmit sounds to a long distance over wire in a clear and at the same time audible manner. That this is so is abundantly shown by the discontent displayed by subscribers to telephonic exchanges, who often say that they cannot distinguish the sounds. Now this faulty articulation frequently tends to render the telephonic sounds inaudible, and also has a prejudicial effect upon the organs of hearing; but it must be recollected that many causes intervene to deprive these sounds of their clearness and distinctness, especially when they are transmitted over a telegraph line influenced by the constant action of accidental currents, such as earth currents, induced currents, atmospheric currents, &c. To counteract these latter on long lines, the wave currents transmitted must have a certain energy, and therefore telephones with batteries have been used; but, as the variations of the resistance of the transmitting apparatus regulating the undulatory currents are always feeble in comparison with the resistance of the entire line, the periods of the electric wave are not sufficiently marked to indicate the minute variations corresponding with those of the articulate sounds, these being more or less effaced by the line resistance, and are disguised by the accidental electric currents. To avoid this difficulty it is necessary to solve two problems: 1st, to increase the volume of the electric vibrations largely without calling for any increase in the volume of the voice, and, 2nd, to arrange that the electric currents which are foreign to those directly transmitted shall not enter the circuit. These are the two problems which Dr. Herz has solved in the telephonic systems of which we have spoken before, but which we now describe in detail.

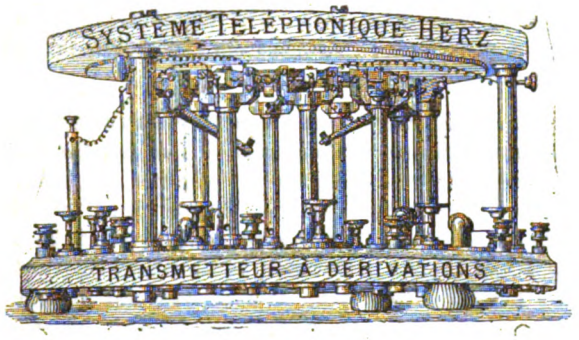

FIG. 1.

Several methods may be employed to strengthen the current: first, the shunt system which we described in a previous article; second, microphonic systems with a large number of badly conducting contacts, but arranged so as not to offer too much resistance; and third, where use is made of undulatory induced currents, transmitted by an induction coil, a system for increasing the volume of the electric waves by prolonging the duration of the induced currents themselves. All these means have been employed by M. Herz, and to our knowledge have given good results. The second portion of the problem has already been solved in cable work by use of condensers. By using an articulating condenser as a receiver, the problem is solved at once by the introduction of the apparatus itself into the circuit; but in using ordinary telephones, the introduction of a number of points or condensers between the apparatus and the earth effects the desired end. In fact it is easily understood that the breaking of the circuit necessarily prevents the propagation of accidental currents, or at all events, if they do arise, which might occur since telephonic transmissions have been obtained in open circuits, prevents them from producing troublesome effects.

We will now describe the arrangement of some of these systems. The first system used in the experiments of last autumn between Brest and Penzance had for a transmitter the apparatus represented in elevation (Fig. 1) in plan (Fig. 2), and the electric arrangements of which are shown in Fig. 3. But in order to explain the principle we must first refer to Fig. 4, in which the condenser and diffuser are shown in circuit. In this fig. the transmitter belongs to the microphonic system, and is in a derived circuit, besides which are shown the other arrangements as adopted. Each of the systems of contacts is composed of a carbon plate or better still of a plate of iron pyrites or pyrolusite, which carry carbon points, or points of pyrites mounted upon balance levers, the pressure of which is regulated at will. These levers are mounted on metal columns as in Fig. 1, where two of the levers are shown disengaged. The badly conducting plates are fixed to the number of 6 upon a vibrating disc forming the upper part of the apparatus, and are ranged circularly round the centre of the disc as shown in Figs. 2 and 3.

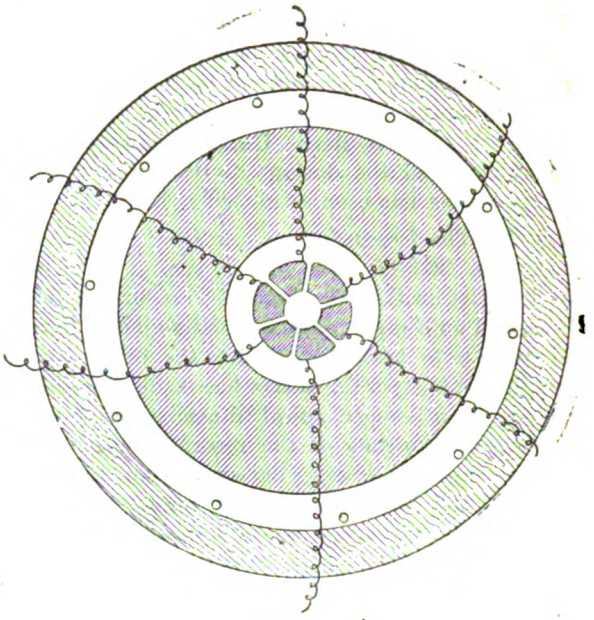

FIG. 2.

Each of the plates of pyrites is connected, as shown in Figs. 3 and 4, with the binding screws of the battery, so that the current from each element traverses each contact, and, as there are two contacts to every plate, the battery should consist of twelve cells, joined up in tension. In order to obtain continuity, and at the same time strength of each separate action, the ends of the contact levers are connected by means of a bifurcated wire conducting from one plate to another, as shown in Figs. 3 and 4. Tracing

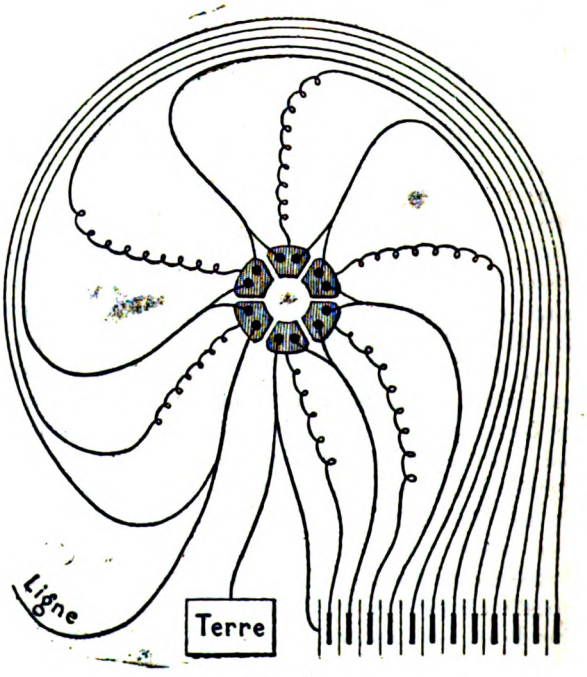

FIG. 3

the course of the current, we see that that of the first cell on the left of the battery goes directly to earth, passing through the first contact on the left of Plate No. 1. The current of the second cell also goes to earth, passing through the second contact of Plate No. 1, and then through the first contact. The current of the third cell passes first through Plate No. 2, the first contact on the left of this plate, the bifurcate wire of the second contact of the first plate, the two contacts of this plate, and then

* From *La Lumière Electrique*

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goes to earth; and so on for all the cells of the battery. As the first cell on the left is in connection with earth, it will be seen that the current of each separate cell has two paths, the circuit of the contacts of the transmitter and the line circuit. This arrangement is adopted in order to decrease, in a large measure, the resistance of the twelve contacts of the transmitter, which is large, and to shunt them to earth, so as to increase the variations of resistance offered by the transmitter. Thus we have two causes of increase of the variations: 1. That resulting from the shunt; 2. That resulting from the increase in the number of contacts; and by means of shunting each battery cell, the total resistance of the transmitter is sensibly decreased. The following calculation shows the importance of the shunt system in this arrangement. Let us call the line circuit b, the derived circuit caused by the transmitter contacts a, the EMF of the battery E, and its resistance r. According to Ohm's formula, we should have as the value of the intensity I, supposing the transmitter with the resistance to be introduced directly into the circuit,

$$I = \frac{E}{r + a + b},$$

and as the value of I, when the transmitter forms the shunt,

$$I' = \frac{E}{r + \frac{rb}{a} + b},$$

this formula differing only from the first by the quantity between r and b, which is a in the first case, and $\frac{rb}{a}$ in the second.

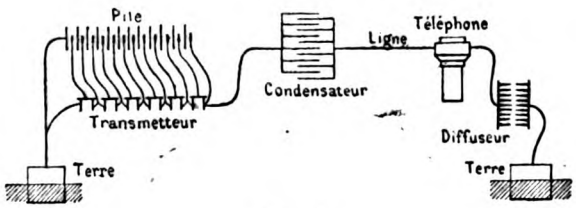

FIG. 4.

Thus it is easily seen, from these two expressions, that the variations of a will affect the value of I far more in the one case than in the other. Let us suppose that $r = 5$ ohms, $a = 10$ ohms, and $b = 100$ ohms; the whole resistance forming the devisor of E will be, in the case of a simple circuit, $5 + 10 + 100 = 115$ ohms, and in the case of a shunted circuit, $5 + \frac{100 \times 5}{10} + 100 = 155$ ohms. Now if, owing to a difference in the pressure of the contacts, a be reduced by 2 ohms, the resistance in the first case will become 113 ohms, but in the second it will reach 168 ohms. According to the variation in intensity, the telephone circuit will be affected in the first case in the ratio of 1 to 1,017, and in the second in the ratio of 1 to 1,084. From this we see how we add to the sensitiveness by the use of the shunt system.

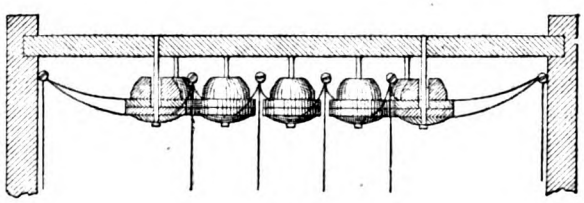

FIG. 5.

In the first experiments made with this transmitter between Brest and Penzance, several kinds of magnet telephones were used as receivers, and they were used with and without a condenser in the line, and also with and without a card of points, as shown in Fig. 4. The results were satisfactory enough to predict in the near future a practical solution of the problem, as will be seen from a perusal of the papers of that period.

In practice the arrangement shown in Fig. 1 has some inconveniences; there is a want of precision in the adjustment of the contact levers, and when regulation is required in telephonic apparatus, the system is not entitled to be called practical. This fault has been avoided in a very simple manner by means of the apparatus shown in vertical section (Fig. 5), and in plan (Fig. 6). In this apparatus the contacts are made of pyritic discs or other metallic sulphides, and are suspended in couples by means of rods to a thin piece of wood which acts as a vibrating disc. In this way the contact surfaces are sufficiently large to diminish the resistance of the apparatus; and to insure good contact, balls of lead rest on each couple of discs, as shown in Fig. 5. The connections are made as illustrated in Fig. 6, and in the same manner as in the first system; except that as there are more plates having double contacts, the number of couples in contact is 12 instead of being 6, and the bifurcated connections are made from an upper disc to a lower one. Experiment has shown that this system can be simplified, and that the number of couples in contact can be reduced to three. The experiments commenced about three months ago with this apparatus between Orleans, Blois, Tours, Poitiers, Angoulême, and Bordeaux, led to important results, which were made public, and in these experiments great attention was paid to the better placing of the battery as regards its connections with the transmitter contacts. Thus, a combination of the battery in series was tried, so that a double cell (joined up in quantity) should act in each contact, at the same time that these different groups of cells were joined up in tension. This arrangement gave good results in some cases, whilst in others the simple cell combination seemed the best.

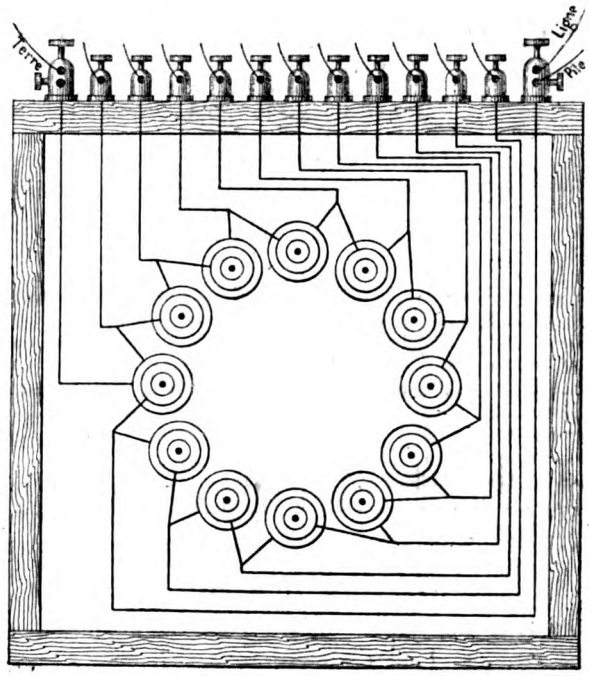

FIG. 6.

In addition to these systems induction coils have been tried, one to each contact; in this case the battery cells were not connected to one another, and separately acted on each contact, the current traversing the primary circuit of each corresponding coil. Here all the secondary circuits were joined up in quantity to their series of coils, and were connected with earth and the line circuit. Good results have been obtained by this system, but it is too complicated. Transmitters with three, six, and twelve pairs of contact discs have also been tried, but always by using the shunt system, and with the number of battery cells equal to that of the disc couples, each cell being itself composed of two cells joined up in quantity, the whole set up in tension with shunts to the transmitter between each cell or group of cells. As receivers, magnetic telephones have been used, and also the articulating condenser, and with regard to this it will be interesting to describe the various experiments which have been made extending over about one year.

(TO BE CONTINUED.)

NATAL.—The Royal Mail steamer "Balmoral Castle," which sails from Dartmouth to-day, with troops for Durban, carries with her 66 tons of telegraph wire.

SIR W. THOMSON.—Sir W. Thomson, who came to London at the beginning of this week, has delivered no fewer than five important lectures during his short stay, one at the Institution of Civil Enginers, one at the Society of Arts, one at the Royal Society, one at the Royal United Service Institution, and one at the Royal Institution,—the two last yesterday (Friday).

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TO OUR READERS.

For a long time past our space has been far too small for the amount of matter awaiting insertion, and arrangements are in progress to enable us to increase the size of the paper by several pages.

THE LATE LIGHT EXHIBITION AT GLASGOW.

The report of the jurors appointed to compare the results obtained from various electric light apparatus entered for such comparison at the recent exhibition at Glasgow is now before us, and the document is at once both satisfactory and unsatisfactory. Its unsatisfactory character results from the fact that the work of the jurors was reduced to a minimum. For reasons which in some cases can hardly be deemed sufficient, apparatus was withdrawn from trial, and so no test was made by the jurors as to its efficacy.

These exhibitions may be considered from different standpoints. The majority are now nothing more nor less than large bazaars. The public go to see, and perhaps to purchase. The manufacturers send their goods to be seen in the hope of selling them and obtaining orders for more of their manufacturers.

Trade advertisements, if absolutely necessary, are not always trustworthy. The statement in an advertisement is necessarily an *ex parte* statement, and allows of no comparison with the goods of a rival maker. These public exhibitions allow of outward comparison at any rate. There are the manufactured articles; you see them, and in many cases can at once determine whether they are or are not suitable for your wants. Seeing, however, is not everything, and although in some cases it is all that is required, in others it has little or nothing to do with the conclusions of the purchaser. No man would buy a steam-engine because it pleased the eye. He would want to know something more about it than is shown by outside appearance, something as to its capabilities, whether it was economical in the use of steam, and so on.

It is well known that wonderful strides have been made in the economy of certain classes of steam engines since the Royal Agricultural Society first instituted its competitive tests. Constructors of engines soon began to find that unless they improved the design of their engine here, and altered for the better there, another maker's engine would produce more useful effect with the same consumption of fuel. The winning of prizes, the standing first in the competitive tests, was, perhaps, a costly work, but it paid. The purchaser of engines was no longer so completely at the mercy of the manufacturer. He knew something as to the work that might be obtained from a particular type of engine, and although under ordinary circumstances he could not hope to obtain so good results from engines built for use as from engines built for exhibition, he could give a pretty shrewd guess as to what such engines ought to do. We again say that, although makers find the first cost of these competitions great, they find the money well expended, and now hardly a firm of repute but boasts of its achievements in these trials. The engines they construct are so nearly of the same economy that the award of a first prize is often the result of the better or worse distribution of half-a-dozen shovels-full of coals. A steam-engine, however, so far as regards principle, is the same now as it was before these trials commenced. You find a boiler, fire-box, cylinders, fly-wheels, &c., now as then. The difference has been caused by the attention paid to details.

The dynamo and the magneto-electric machines stand somewhat on the same grounds, when economy is considered, as the steam-engine. The broad principle upon which these machines are constructed is known, and there is no likelihood of any radical alteration in principle. Their efficiency, then, is more a question of detail. Every part should be considered in relation to the whole and the other parts. Every part should be designed in view of the purpose for which it is intended, and till every part is so designed and is mathematically proportioned to give the best effect, the machines will not be perfect. We never expect to obtain a perfect machine; therefore, there seems to be an unlimited field for improvement. If we consider the question of electric lamps we should again see that there is also here an unlimited field for improvement.

The Royal Agricultural Society's experimental tests having done so much for steam, might we not safely conclude that similar experimental tests by recognised authorities would produce a similar effect in the development of the electric machine. One question always remains. Have makers faith enough in their own machines to submit them to the tests prescribed in the competition? The answer such a question is not at present forthcoming.

The exhibition under the auspices of the Philosophical Society of Glasgow was surely one sufficiently influential to confer more than an ordinary share of honour to the competitor in electrical light apparatus who succeeded in gaining the premier position. Four systems of lamps were shown—Mackenzie's, worked by a Gramme machine; Serrin-Lontin's, by a Lontin machine; the Brush, worked by a Brush machine; and Crompton's, worked by a Gramme machine. Only two systems were

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finally offered for testing, the "Brush" and the "Crompton," and, unfortunately, the heart of one of the competitors failed, and the "Brush" system was withdrawn. We quite understand the meaning of the arguments in favour of such withdrawal, but everyone will not be slow to realise the real cause. The report says:—"The 'Brush' machines were, however, withdrawn from competition (arranged for Nov. 5th) late on the night of Thursday, Nov. 4th, and by a telegram to their representative in Glasgow, Mr. Allen, on Friday morning, Nov. 5th, after the committee had at great labour and considerable expense made full preparations for an exhaustive test and measurement." We know that a great show of figures is made with regard to the Brush system. Our contemporary *Engineering* has published some excellent articles on the system; but, with all due deference to the enterprise and energy of that journal, we should prefer the figures from tests made by such men as those who comprised the jurors at Glasgow. If we mistake not, the figures we refer to have been obtained from American sources. We do not for one moment doubt the perfect honesty of the experimenters who obtained such figures, but we prefer to make the tests personally, or to obtain the results of tests by unbiassed observers, and to know the exact manner in which the results were obtained. It is very singular that one so seldom finds the "advertised figures" agreeing with the figures obtained in a public competition.

So the competition proved to be no competition after all. The data obtained in respect to the Crompton lamp will, however, undoubtedly prove the data from which all inventors of arc lamps will work. Such lamps will be tested privately, and unless the results are equal to or surpass those published by the Glasgow jurors we may rest assured that the lamps will not be entered at any competition. One great gain has resulted from the public testing of this lamp; it has given us a starting point. The same may be said in regard to the Gramme machines. The competition here was between different makers of the same type of machine; but, again, unless the Brush, Bürgin, Elphinstone-Vincent, Fitz-Gerald, Ferry, Siemens, &c., machines give as good results, they will not compete for the purpose of supplying the current for arc lamps. In a short time more attention will be paid to the results of these public competitions than the inventors seem to consider possible. Purchasers will not long be compelled to use one or other of two or three lamps, or of two machines, but will have a variety to choose from, and will necessarily look to unbiassed quarters for recommendation or otherwise.

At the present time only the Siemens and Gramme machines can be said to be recommended. These types are in extensive use. Some authorities favour the one, some the other. The Siemens system was not exhibited at Glasgow, but it has more than once been publicly tested and reported upon. There is one feature in the Siemens system which has never been sufficiently noticed. It is a progressive system. Work and thought are continually expended upon it, so that we may expect good results in any tests which it may undergo, and the results ought to be better at every succeeding epoch.

THE PHYSICAL SOCIETY.

FEB. 26.—Professor FULLER in the Chair.

ELECTRICAL ILLUSTRATIONS.

Dr. O. J. LODGE exhibited a mechanical device illustrating how it is that conductors of electricity may be opaque to light. The conductor was represented by a row of balls mounted on parallel bars rigidly fixed across the mouth of a wooden trough. An elastic pipe connected the balls together, and when a wave was sent along the pipe the balls destroyed it because of their rigidity of position; in other words, the light wave was not propagated through the row of balls. On the other hand, when the row of balls were mounted on elastic springs the wave propagated itself through them, as light does through a transparent body.

Dr. Lodge also showed an ingenious application of Wheatstone's photometer, to illustrate the rotation of the plane of polarised light on entering a magnetic medium. The rectilinear motion of the bright bead in this photometer is really a harmonic motion compounded of two circular motions, and accelerating one of these circular motions, the right line along which the bead travels is found to shift its place through a certain angle. The same thing happens when a beam of polarised light is sent through a magnetic medium; in other words, the plane of polarisation is shifted round.

A NEW INTEGRATING MACHINE.

Mr. C. V. BOYS exhibited a novel integrating machine of his construction, which is based on the mathematical theory of integration, and serves to illustrate it. Though in a practical sense not superior to Amsler's well-known apparatus, it is nevertheless well adapted for use in teaching mathematics and mathematical physics.

ON THE TELEGRAPHIC TRANSMISSION OF PICTURES OF NATURAL OBJECTS.

Mr. SHELFORD BIDWELL exhibited his "tele-photograph" for transmitting images by wire. In our last number we illustrated this device, and need not, therefore, do more than briefly describe it now.

The following experiment explains the nature of the process:—The positive pole of a battery is connected through a set of resistance coils to a piece of platinum wire, and the negative pole to a plate of zinc, upon which is placed a sheet of paper moistened with a solution of potassium iodide. The *negative* pole of a second battery is connected through a selenium cell with the same platinum wire, and the positive pole to the zinc plate. The point of the platinum wire is pressed upon the paper, and the selenium being exposed to a strong light, the variable resistance is so adjusted that the currents from the two batteries which pass through the paper in opposite directions exactly neutralise each other. The platinum point will now make no mark when drawn over the paper; but if the selenium is shaded its resistance is immediately increased, the current from the first battery then predominates, and the path of the platinum point across the paper is marked by a brown line due to the liberation of iodine. When a feeble light is thrown upon the selenium the intensity of the line is diminished, and it becomes fainter as the light increases. A delicate cell will produce these effects even when shielded by a screen in which is pierced a hole, the diameter of which is only $\frac{1}{20}$ of an inch. These results have been applied in the "tele-photographic" instruments exhibited. The transmitter consists of a cylindrical box mounted upon a spindle, which is divided in the middle by an insulating joint. The spindle, one end of which has a screw cut upon it of sixty-four threads to the inch, revolves in two brass bearings, the distance between which is equal to twice the length of the cylinder, and moves laterally through $\frac{1}{64}$ of an inch during each revolution. In the middle of the cylinder is a pin-hole, and behind this is fixed a selenium cell, which is connected through the two halves of the spindle to two terminals in the stand of the instrument. The receiving instrument contains a similar metallic cylinder, similarly mounted, and connected to a terminal, a platinum point which presses upon the cylinder being connected to a second terminal. The two instruments are joined up just as in the preliminary experiment, two batteries and a set of resistance coils being used. The image to be transmitted is focussed upon the cylinder of the transmitter, the resistance adjusted, and the receiving cylinder covered with sensitised paper. The two cylinders are caused to rotate synchronously, the pin-hole in the course of its spiral path covering successively every point of the focussed picture. The amount of light falling upon the selenium will be proportional to the illumination of that particular spot of the projected image, which is, for the time being, occupied by the pin-hole, and the intensity of the line traced by the platinum point in the receiver will vary in the same proportion. These variations will produce a picture, which, if the instrument were perfect, would be a counterpart of that projected upon the transmitter. Simple designs cut out of tin foil and projected by a lantern have been successfully transmitted. With selenium and paper of greater sensitiveness more perfect results might undoubtedly be obtained.

A subsidiary result of Mr. Bidwell's experiments is worthy of mention, since it would appear to contradict some observations

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made by others. He finds from three of his selenium cells put to the test that cells of *high resistance are more sensitive to light than those of low resistance*. It follows that a high resistance cell is best for the tele-photograph. Professor Ayrton has also found this to be the case in his experiments on telephoty. It is somewhat unfortunate that selenium is so capricious a substance. Not only does its photo-electric power alter by time, but it is non-uniform for the same cell, so that one part of a receiving cell may be more sensitive to light than another. This being so, there is a tendency to distort the copy of the luminous image produced at the other end, unless the difficulty is overcome either by better manufacture of the cells or by an improved mode of employing them. The chemical paper is another drawback, and a more sensitive paper than Bain's iodide of potassium paper is desirable. Perhaps the photographic compounds may furnish such a paper. The synchronising of the motions of the transmitter and receiver is another mechanical drawback to Mr. Bidwell's tele-photograph as at present made, and it has been the weak point in Bakewell's and D'Arlingcourt's copying telegraphs. It is not easy to see how he can dispense with it, but, perhaps, a way out of the difficulty will present itself to his mind. Dr. Coffin pointed out to the Physical Society that the convex cylindrical receiving surface on which the image is reproduced is not the best that could have been selected, and suggested a concave rather than a convex one. He also suggested that the image should first be focussed on a mirror, which could be moved across the orifice, or pin-hole, so as to shine in on the selenium cell, instead of keeping the image fixed and shifting the hole itself.

Seeing by Electricity.

Professors Ayrton and Perry exhibited an experiment to show how a light and shade image could be reproduced at the distant end of a wire. The device consisted of a selenium cell in circuit, with a battery and a galvanometer coil of wire, enclosing a tube through which a beam of light from an electric lantern was passed and allowed to fall upon a screen, where it made a bright spot. A light circular shutter carrying a small magnet was suspended in the tube by a silk thread, after the manner of the needle in the mirror galvanometer, so that when a current circulated in the coils the magnet would be deflected more or less, and the shutter likewise closed, more or less, according to the strength of the current. In this way the light would be shut off, and the spot on the screen would fade in proportion to the strength of the current. Now, the strength of the current would, by the principle of the selenium cell, depend on the intensity of the luminous image falling on the cell in circuit with the coil. The idea of Professors Ayrton and Perry is to have a mosaic surface of these cells to receive the image of an object to be transmitted, and to connect each of them in circuit with an electro-magnetic shutter of the kind described, so that each part of the image, whether it be light or dark, should reproduce a corresponding part on the general screen at the other end of the line. To avoid the necessity of having a great number of independent circuits, the idea has occurred to them to employ for the transmitter an arm carrying a series of selenium cells, and rotating so rapidly that its effect would be the same optically as a continuous circular screen. For a receiver, too, they have also bethought them of the magic mirror of Japan, which they have shown to yield its magical pictures owing to inequalities in the curvature of its surface. By having a set of electro-magnets in circuit with the selenium transmitting cells, and fixing behind the mirror, they may, perhaps, be able to produce a distortion of the surface curvature (if we apprehend their design aright) which will give a picture of the transmitted image on the mirror.

"The Plaint of a Gas Engineer."—At the annual dinner of the Southern District Association of Gas Engineers and Managers, a new song was sung with the above title, one or two verses of which we may appropriately give:—

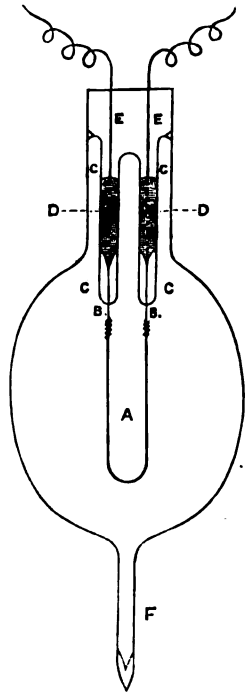
V. 3. His customers say that their bills are too high;
Lord Redesdale—"The standard's too low;"
While *Edison* swears that the *E*-lectric light
Will bring our concerns all to woe.
Chorus— But throwing off all his trouble and care,
He sings, "*Nil Desperandum*, I'll never despair."

V. 6. Sometimes the *Exchange* tries to lower his stock
By creating what is called a "scare;"
But the *Gas Engineer* cares little for this,
He calls it the egg of a mare.
Thus throwing off all his trouble and care,
He sings, "*Nil Desperandum*, I'll never despair."

MR. ST. GEORGE LANE FOX'S SYSTEM OF ELECTRIC LIGHTING.

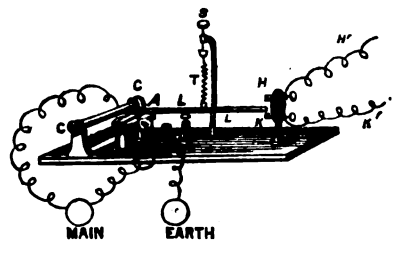
Mr. Lane Fox's new lamp and improved system of current regulation having excited considerable interest of late, we are glad to be able to place before our readers diagrams of the apparatus, and a description of the special features of Mr. Fox's inventions. As regards the lamp, it will be seen (Fig. 1) that in

FIG. 1.



general form it resembles Mr. Swan's; but the materials employed, as also the details of construction, are decidedly novel, and claim to be superior to those employed by the Newcastle inventor. In the first place, the pump used for exhausting the glass globe has been devised specially for the purpose, and will, it is alleged, produce a far more perfect vacuum than that obtainable by means of the Sprengel pump. For the manufacture of the carbon filaments (A) a thread of flax or cotton is wound round a block of carbon or graphite of the required shape, and the whole enclosed in a crucible hermetically sealed, which is then raised to a white heat. The threads thus carbonised are afterwards separately mounted in an atmosphere of coal gas and benzole, and a current being passed through them sufficient to render them incandescent, a deposit of hard carbon is formed upon their surface. The difficulty of getting a sufficient current through the thread in the first instance is got over by making short circuit through a large electro-magnet

FIG. 2.



of low resistance, and then suddenly interrupting the short circuit, whereupon the extra current will momentarily raise the thread to a white heat, and on repeating this operation several times a sufficient deposit of carbon is obtained. The ends of the threads are thrust tightly into small spirals attached to the platinum wires B, B, fused into the glass tubes C, C. These tubes contain mercury, which covers the platinum wires, and into which dip the conducting wires, E, E. The lamp so constructed is attached to the exhausting pump by the tube F, and the bridge (A) being raised to incandescence by an electric current the exhaustion is continued for about two days. The light obtainable from this form of lamp is said to be very economical, and the filaments, proper care being taken in controlling the current, very durable.

Mr. Lane Fox's method of distributing electricity for public lighting purposes consists of mains under the roadway, with

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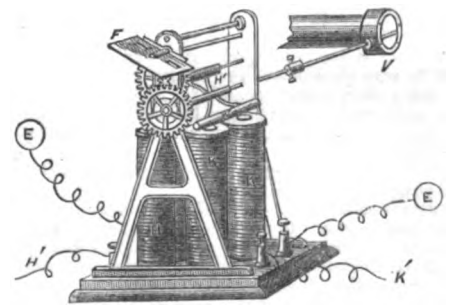
central generating stations similar to those employed for the distribution of gas. These mains are charged at a constant electromotive force; and the lamps, connected in multiple arc between the mains and earth, have each one wire to earth and one wire to a switch communicating at pleasure with the main. Figs. 2 and 3 represent the regulators for maintaining a constant force in the mains. The lever L, connected with a main and actuated by an electro-magnet M, is balanced by the spring T at exactly the normal electromotive force. Any disturbance of this normal force by increase or diminution of the number of lamps alight in the circuit, will put the lever in communication with the electro-magnets H K (Fig. 3). A throttle valve V, attracted to the armature of these magnets regulates the steam supply of the engine, the speed of which will therefore be determined by the action of H.K. By this means Mr. Lane Fox proposes to make the steam power generated, and consequently the electric power, always commensurate with the demand upon the electric mains. We think further consideration of this scheme to regulate the revolutions of the engine will show that it is far from being a good one.

FIG. 3.



SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS—FEB. 25TH, 1881.

The adjourned discussion of Mr. Adams's paper on earth currents was opened by the reading of a short communication from Mr. TRACEY relating to currents upon the Scotch Norwegian cable observed in the year 1878. It was noticed that the direction of the currents changed uniformly four times in twenty-four hours, rising for three hours and then falling for three hours. His attention had subsequently been drawn to the coincidence of these changes with the tidal changes.

Mr. W. ELLIS furnished some details of the last magnetic storm on January 31st, recorded at the Greenwich Observatory. Magnetic disturbances were in all cases accompanied by and identical in intensity with earth currents. He also pointed out that these disturbances were always most marked at periods when sun spots were most manifest. It is on record also that on the occasions of sudden disturbances of the sun sudden magnetic disturbances invariably accompany them; but it was noticeable that the electrical condition of the atmosphere was not similarly disturbed.

Mr. C. F. VARLEY had had many communications with the Astronomer Royal on the subject of these earth currents, and had pointed out that the apparent currents on lines over land were by no means reliable as regards their true direction, the difference in the conductivity of the rock and land and that of the ocean giving rise to departures from the proper course of the current. The only safe way of determining the direction would be, Mr. Varley suggested, to have four submarine wires brought to hand on the four opposite sides of a small island, and the currents examined north, south, east, and west. No sensible rocking of the earth had ever been discovered, though this had been suggested to account for the earth currents in question. But this was not the case with the atmosphere, which at the equator was known to exhibit variation tending to shape itself into an elliptical form. Attenuated air was a conductor, and at the heights of 20 to 40 miles its vastly increased conductivity, if highly charged with electricity, would when in motion account for atmospheric electrical tides. He concluded by encouraging Mr. Adams to persevere with his careful observations of the phenomenon he had so industriously taken in hand.

Mr. BANKER, of the Postal Telegraph service, read a paper casting doubts upon the lunar theory, preferred by Mr. Adams and others, to account for the earth currents, he, Mr. Banker, adducing a considerable amount of evidence in proof that they were due rather to the thermal differential state of the atmosphere—that the prime cause was solar and not lunar.

Mr. WILLOUGHBY SMITH described some experiments he had made with cables across the Thames with a view of testing Faraday's suggestion as mentioned by Mr. Wollaston at the last meeting. But it turned out that the exact nature of the suggestion had not been understood, for one end of these cables was insulated, whereas the condition necessary for obtaining the current was that both ends of the wires should be earthed. Mr. Smith also exhibited large diagrams of earth current curves noticed on deep sea cables; but the observations were only for short periods of time, and nothing conclusive could be inferred from them.

Mr. SPAGNOLETTI had also caused wires under the Thames to be tested, but the experiments had not been very accurately carried out.

Mr. WOLLASTON reaffirmed the statements he had made at the preceding meeting. He had made similar experiments to those of which he had previously spoken in the Thames, always with the result that the current rises and falls, ebbs and flows, exactly corresponding with the set of the tide. In South Africa he had noticed the same effects on a wire suspended over the river Gamtoos very close to the water, and the currents were invariably found to be running as the river tide ran.

At this point Mr. GRAVES corrected the statement that there was a submarine cable in the length of wire tested by Mr. Adams between London and Cardiff, vitiating the records taken on that wire; but Mr. WOLLASTON promptly retorted that if not under the water the wire was *over* it.

Sir CHARLES BRIGHT inquired if any explanation was offered of this curious effect of running water upon submerged or suspended wire, whereupon

Professor AYRTON stated that the explanation was very simple. The river flowed over lines of magnetic force, and acted as any other conductor would do cutting such lines—a current was set up in the earth, and a small portion of this current would travel by way of the wire.

This account of its action was questioned by Mr. MUNRO.

Mr. WINTER here referred to the experiments instituted by him in Madras four years ago, which were described in the Society's *Journal* at the time.

Professor AYRTON then resumed his remarks, which were mainly directed against Professor Adams's criticism of Professors Ayrton and Perry's theory with respect to the earth's magnetism. As touching the immediate subject in hand, he, Professor Ayrton, could easily account for earth currents by the differing position of the moon in relation to the earth's surface. Assuming the moon to be an electrified body, it was obvious that different points of the earth being at different distances from that body would be in different electrical conditions, and currents would necessarily flow from one point to the other. There was no doubt as to this being an explanation of earth currents.

A short communication from Mr. W. H. PREECE, describing the electrical disturbance of January 31, concluded the proceedings.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY (LIMITED).

The seventeenth ordinary meeting of the shareholders in this Company was held at the City Terminus Hotel, Cannon-street, on the 1st inst., under the presidency of Sir D. Gooch, Bart., M.P.

The SECRETARY (Mr. W. Shuter) read the notice convening the meeting, and the minutes of the sixteenth ordinary meeting held on the 2nd March, 1880, and of the half-yearly meeting held on the 20th July last, which were approved by the present meeting and signed by the Chairman. The directors' report, which appeared in *The Electrician* of last week, was taken as read.

The CHAIRMAN then moved the following resolution:—"That the report and accounts of the directors to the 31st December, 1880, submitted to this meeting be, and the same are, hereby received and adopted, and that a dividend of 36s. per share (in addition to the 12s. per share interest or interim dividend paid to the 30th June, 1880) be paid upon all shares of the Company for the year ending 31st December, 1880, and that such dividend be paid free of income-tax." Before putting the resolution I may call your attention, perhaps, to the work we have been doing. We meet this year with less work carried over than we have been in the habit of doing for some time past, and therefore your accounts show no accurate state of your affairs at the present time. During the year, as you see by the report, we have finished the Eastern Extension Telegraph Company's duplicate Australian cable; we have laid a cable 108 miles in length, connecting the northern and middle islands of New Zealand; we have laid a cable between the island of Luzon and Hong Kong, 299 miles in length; we have repaired the 1866 cable for the Anglo-American Company by relaying an intermediate portion between the shore ends and the deep sea cable; and we have also laid a cable for the Great Northern Company connecting Newbiggin, on the east coast of England, with Arendal, in Norway, and Arendal with Marstand, on the coast of Sweden, the total length of this cable being 518 miles. The total length of cable made in 1880 amounted to 3,453 miles. The work we have in hand is only small lengths of cable, and what the future may bring forth I am not able to prophesy. You can all form your own opinion as well as I as to more cables being required. We must hope that orders will come in for longer cables. The Cape cable, as you are aware, was completed and opened before the commencement of 1880, and I think we must all feel pleasure in knowing what an important part we took in the completion and making of that cable. This Company and the Eastern Company were the only parties who found any money for laying that cable, and it was with great difficulty we succeeded in getting anything like assistance or help from the Government. I think the Government must congratulate themselves—and I think they ought to thank us—on having had that cable during the last 12 months. It is very sad to hear the news we have had, but it comes in a way that must be very useful to the Government departments. We have chartered the "Calabria," one of our large ships, for carrying troops to the Cape. She sailed on Sunday from Kingstown, and was very satisfactorily fitted and completed to the satisfaction of the Government superintendent. I may state with regard to the accounts that we have done as hitherto—made very large and ample reserves, and we have declared the same dividend as we have been paying the last three years. There is no doubt that we might have paid a larger dividend; but looking to the circumstances of the Company, the directors are of opinion that it was wiser in your interests to declare the dividend we have declared. I shall be very glad to answer any question with regard to the accounts in detail, but they are not of such a nature that I can go into them to be of any interest to you. I now propose the resolution I have read.

Sir GEORGE ELLIOT, Bart., seconded the motion, which was at once carried unanimously.

The CHAIRMAN: The dividend warrants will be posted to-night

Sir GEORGE ELLIOT moved the re-election of Sir Daniel Gooch, Bart., M.P., to his seat at the board.

Mr. PHILIP RAWSON seconded the motion, which was carried unanimously.

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On the motion of the CHAIRMAN, seconded by Vice-Admiral Sir GEORGE H. RICHARDS, C.B., F.R.S. (the managing director), Sir Thomas Fairbairn, Bart., was also re-elected a director.

Mr. WILLIAM ABBOTT, in moving the re-appointment of the auditors—Mr. John Gane and Mr. James Glegg—expressed his complete satisfaction with the dividend which had been declared and the policy the directors had adopted of making large reserves. He would be glad to know if there was any prospect of their obtaining a fair share of the business now likely to come to manufacturing companies in connection with the electric light. He had no doubt, for his own part, that they would have a fair share of such business, and he presumed they were taking steps with that object.

Mr. BENSON having seconded the re-election of the auditors, the motion was carried unanimously.

The CHAIRMAN: That concludes the business. With regard to electric lighting, we shall do all we can to secure any orders for cables or whatever may be necessary for that; but what they are using now is of a very rough kind. I have had an opportunity of seeing some of it, and it seems nothing but wire covered with tarry hemp.

On the motion of Mr. ABBOTT, seconded by Mr. BENSON, a hearty vote of thanks was passed to the Chairman and Directors.

The CHAIRMAN: We are much obliged to you, gentlemen. We shall do all we can for your interests.

The proceedings then terminated.

DIRECT UNITED STATES CABLE COMPANY (LIMITED).

The seventh ordinary general meeting of this Company was held on the 25th inst., at the Cannon-street Hotel, under the presidency of Mr. John Pender, M.P.

The ACTING SECRETARY (Mr. T. Finnis) having read the notice convening the meeting, the report of the directors was taken as read. It stated, *inter alia*, that the £100,000 debenture loan had been received in full. An interruption occurred in the short section of the cable on Brown's Bank on the 23rd December, 1880, and was repaired on the 4th January, 1881. Another interruption occurred in the same section and in the same locality on the 18th January, 1881, and was repaired on the 27th January, 1881. These prompt repairs were effected by the s.s. "Minia," under the command of Captain Trott, who reported that the breakage in each case had been caused by ship's anchors.

The CHAIRMAN: Gentlemen, domestic affliction prevented my being present at the last meeting, when the agreement with the French Company was ratified by the shareholders. Since then all the documents between the three companies—that is, the Anglo-American, the Direct, and the French Companies—have been completed. I have now the pleasure to make a few remarks upon the report which is in your hands, and which you will observe is of a very satisfactory nature. The revenue for the half year ending the 31st December last, after deducting outpayments, amounted to £59,815 6s. 5d., and the working and other expenses, interest on debentures, income-tax, &c., absorbed £26,233 8s. 11d., leaving a balance of £33,581 17s. 6d., as the net profit for the half year, making, with £21,760 8s. 10d. brought from the previous half year, a total of £55,342 6s. 4d. This amount has been appropriated in the following manner:—Interim dividend to 30th September £15,177 10s., interim dividend to 31st December £15,177 10s., set aside to reserve fund £21,870 8s. 9d., and the balance of £3,116 17s. 7d. has been carried forward. Owing to competitive tariffs, the revenue for the last half year will afford no reliable comparison with that earned in the corresponding period of 1879. The difference, however, is no less than £60,630 against the half year under review; but when we remember that messages were being carried at the very low rates of 6d. and 1s. 6d. per word during a portion of that period against 3s. per word in 1879, the reduction is not very surprising, and had we not returned to a more remunerative tariff in October last, the decrease would have been very much greater. The normal working charges in London and at stations, shown in the accounts under abstracts A and B, are the same within a few pounds as in the corresponding period of the preceding year, a comparison of detail is, therefore, unnecessary. Taking the expenditure as a whole, it shows a slight reduction as compared with 1879; and bearing in mind that the low tariffs, while bringing in less revenue caused a very large increase in the work to be performed, it is satisfactory to find that the extra work has been accomplished without any extra expenditure. The reduction of the tariff from 3s. to 2s. is a benefit which it is hoped the telegraph public will fully appreciate, while we may expect a large increased traffic to result from it. As to the future of Atlantic telegraphy, there can be little doubt that we shall see a great increase stimulated by low rates, good management, and proper facilities. It was my intention to have gone somewhat into detail at the present meeting as to the condition and prospects of Atlantic telegraphy generally, but circumstances, of which doubtless you are all aware, have arisen in America which for the present have given rise to litigation. Your directors have always been desirous to maintain their engagements with other companies, and having contracts with certain landlines in America, which we believe at the present moment are in jeopardy, we have been obliged to take legal steps to protect your interests. While these proceedings are pending it would not be prudent for me in any way to enter into details, or by any observations to prejudice the case one way or the other. It will be sufficient for me to tell you that we are most narrowly watching your interests, and so far as the suits in America are concerned up to the present moment we believe with success. On this point I may mention that when the present Direct Company was established, we pledged ourselves to preserve intact every existing agreement of the old company, and we have most faithfully observed every one of those obligations. In like manner I wish it to be understood that in our working arrangements with other cable companies, the agreements of those companies are most strictly preserved, and obligations for their performance secured. We believe that with the experience we now have, and the ample telegraphing power possessed by the existing Atlantic Cable companies, and having regard to the fact that the policy of those companies is the development of traffic by reducing rates and thereby benefiting the public and the shareholders at the same time, we are always certain, with such a policy, to command a very large share of public patronage. We rely that with good management we shall secure this, and, therefore, we look forward with considerable hope to the future. There is one point which I think it is well that the telegraphing public should know—not only in England, but at the present moment in America—and that is, that in any working arrangements with other cable companies, our individual independence and obligations have been preserved, and such arrangements have always resulted in reduced rates, so that the public have largely benefited. It is also important that the telegraphing public should know the company's dividend has never exceeded 5 per cent. per annum, and as cable property must always be a somewhat uncertain property, this dividend is too small for the great risks run. I wish these remarks to go abroad widespread, as showing the policy of the present Atlantic Submarine Telegraph companies, and I believe the more widely spread the better will the policy we have laid down be understood and appreciated by those who are so deeply interested in telegraphy generally. With these remarks, gentlemen, I beg to move the adoption of the report.

Mr. WILLIAM FORD seconded the motion.

The CHAIRMAN: If any gentleman has any remarks to make or questions to put I shall be very glad to answer before putting the resolution to the meeting. After a short pause he added: As there is no one present who wishes to ask any questions, I will put the motion. The resolution having been carried unanimously, the Chairman formally intimated that that closed the business of the meeting.

On the motion of Mr. VARLEY, a vote of thanks was passed to the Chairman and directors, and in reply,

The CHAIRMAN said: On behalf of my colleagues and myself, we are very much obliged to you. I can only tell you that the present are rather anxious times, and it is not board meetings, but almost hourly meetings just now, that we are holding for the protection of your interests, and I hope that we are holding them to good purpose.

The proceedings then terminated.

[The above report appeared in our Special Edition of last week.

TRAFFIC RECEIPTS FOR FEBRUARY, 1881.

COMPANIES.	Feb., 1881.	Feb., 1880.	Incrse.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company.....	—	—	—	—
Cuba Submarine Company.....	2,900 estd.	3,140	—	240
Direct Spanish Telegraph Company	—	—	—	—
Direct United States Telegraph Company ...	16,390	—	—	—
Eastern Telegraph Company	46,463	44,591	1,872	—
Eastern Extension Telegraph Company	28,021	25,190	2,831	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company..	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company.	—	—	—	—

ADDRESSES.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

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Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.

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Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

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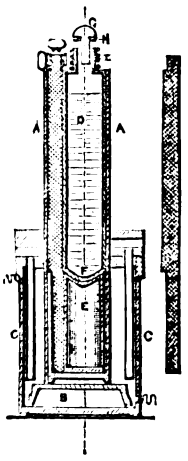
ABSTRACTS OF SPECIFICATIONS.

2597. Improvements in Electric Batteries, *A. V. Newton.—Dated 25th June*, 1880.—(*A communication from T. Tommassi.*) 6*d*.

This invention relates to two fluid batteries, and the intention is to provide for a constant strength of acid, by the admission of fresh acid as wanted. The drawing shows a section of the battery. A is the porous pot with lower end conical in shape, containing the glass vessel D. The outer cell C is half the depth of A, and contains the earthenware piece B on which E, a stand, rests carrying D, which has a small opening, F, for the discharge of the acid. D is fitted with a stopper, G, under the flange of which is a washer, H, to seal opening and prevent air getting into D. A spring, I, allows of the raising of G and the admission of air, the quantity admitted regulating the acid expelled. An arrangement is made to allow the escape of the exhausted acid on the introduction of the new, also for the constant amalgamation of the zincs. In order to increase as much as possible the acting surface of the zinc element of the battery, it will, by preference, take the form of a series of rods or blades, which are suspended from a slotted metal ring, or it may be from an insulating cover carried by the glazed cell. A second metal ring, preferably of zinc, and formed with radial grooves on its under surface, overlies the heads of the zinc rods or blades, their heads entering the radial grooves of the ring for the purpose of ensuring perfect metallic contact between all the blades. In some cases these rods or blades are caused to rest in a bath of mercury contained in an annular gutter formed in the earthenware or glass support for the porous pot. The amalgamation of the zinc rods will thus be maintained, and the rods will gradually sink down as they are consumed. The suspending and connecting rings will in this case be unnecessary, as the mercury will ensure perfect metallic contact between the zinc rods, and a rod protected by a coating of gutta percha or other insulating material dips into the mercury in the trough, and serves to connect the wire to the zinc. In order to maintain the supply of acid to the outer cells of the battery, and to remove the surcharged liquor therefrom, these vessels are pierced with holes near their top for the admission of fresh acid, and near their bottom for the escape of surcharged acid, and they are placed in an acid bath, the holes for admitting and emitting the acid to and from the outer cell being guarded by serpentine glass tubes, which will offer sufficient resistance to the passage of the electric current. The varying specific gravity of the acid within the outer cell will ensure a slow circulation of the acid, the heavier portion escaping by the bottom holes into the bath, and the fresh acid entering the cells at the upper holes, so as to maintain the level of the acid in the cells. The supply of dilute acid to the bath may be regulated by any convenient arrangement of cocks and overflow pipes. The claims are—First. The arrangement within the porous port of the vessel for maintaining a supply of acid to the pot, and in combination therewith the means for regulating and stopping off the supply. Second. The arrangement of the vessel, stand, and carbon within the porous pot. Third. The arrangement of the negative or zinc element of the battery. Fourth. The arrangement, above described, for maintaining a circulation of the dilute acid in the outer cells of the battery.

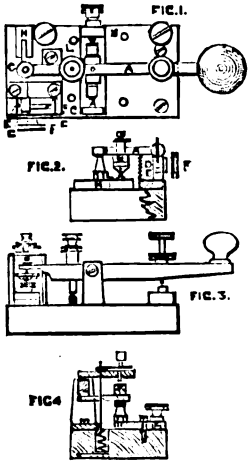
2597



2710. Telegraph Apparatus, *C. Kesseler.—(A communication from F. Fuchs.)—Dated 2nd July*, 1880. 6*d*.

This improvement relates to an additional lever required by a Morse key, according to the circuit on which it is used. Two forms of arrangement of this contact lever are described, Figs. 1 and 2 showing first arrangement, Figs. 3 and 4 the other. It will suffice to describe one; the figures will show the difference in the other. The contact lever in Figs. 1 and 2 consists of a lever proper, A, fulcrum at B, an adjustible contact screw, C; a helical spring, D. The bracket E supports B between centres G G¹, carrying bending screw F. Under the outer end of A is an earth contact plate, carrying a pillar with binding screw. The supporting bracket E is fastened to bed-plate of Morse key by two wood screws, H being fastened by one screw. The earth contact plate L of the Morse key is shortened at both ends, and limits the action of A. Figs. 3 and 4 show other arrangement. The mode in which telegraphing is carried on is as follows:—If the key at station one is depressed, the contact screw on the contact lever B being set properly, the connection between the latter and the earth contact plate is interrupted at the pillar, and the electro-magnet coils of the apparatus separated from each other—that is, the coil is thrown out of circuit; but in the moment the key lever A touches the contact screw the battery is closed, and the current therefrom passes through coil into the line wire. At the station B, where there is still contact, the current traverses the two coils of the apparatus and then goes to earth. When the return spring of the armature is properly regulated the apparatus at A, where the current only passes through one coil, does not speak, whereas the apparatus at B, where the magnetic influence on the armature is about double that of A, gives off writing. If the key at A and that at B are simultaneously depressed, a coil is thrown out at both stations; but as now also the batteries of both stations which are placed against earth with their opposite poles send their current into the line wire, and as moreover a coil is traversed by a current of double the strength than when speaking, and hence, the magnetic influence on the armature is as great as when the current from one battery traversed both coils, it follows that the apparatus must write both at A and B. As soon as now the key on one station drops into its normal state of rest, the current in the line wire falls to half its strength, and the armature of the apparatus on the other station falls off. This telegraphing is conditional on the approximate assimilation of the batteries. The resistance of one battery must also be made as like that of the coil, as possible. This latter is not of much consequence on long distances, but on short distances current variations become apparent if this condition is not fulfilled. They may, however, be easily obviated by including a constant artificial resistance in the battery branch. Experience has further shown that this circuit connection will not work in line wires whose loading capacity exceeds eight microfarads, corresponding to an overground line of about 400 kilometers, or say 250 miles. If it is required to telegraph at greater distances, the number of windings in the coil must be increased, or the electro-magnet cores must be parted from each other by cutting through the connecting piece, or, what appears the best, a transfer must be put in the circuit. For the purpose of this transfer the telegraph apparatus must be provided with a fork shaped contact lever, acting on the same principle as the contact lever of the key. The writing lever, which here takes the place of the key lever of the Morse key, has on its upper surface where it is the position of rest touches the contact lever a small ivory peg. The action of this transfer appliance explains itself from the above explanations of the current circuit. By the arrangement here shown the bed plate or board of the ordinary Morse key can contain also the extra lever; hence it is only necessary to screw a new part to the bed plate, to shorten the earth contact plate or to modify its form, and to alter the end of the key lever A in height according to the requirements of the new combination.

2710



2980. Regulators for Electric Lamps, *A. M. Clark.—Dated 20th July*, 1880.—(*A communication from J. H. Guest.—Not proceeded with.*) 2*d*.

This invention is for automatic regulation of the length of arc and to prevent fluctuation in the light of electric lamps. It consists, first, in a thermoscopic rod combined with an electric lamp for expansion, according to intensity of current and resistance. The lineal expansion is multiplied by levers, which act by clamps to separate the carbons. It also consists in the combination with the expansion rod of a section of carbon, or metal of low conductivity, whereby the heat due to resistance is rapidly generated and dissipated also in a shunt for dividing the current when the carbons are separated to a definite point, and other details which render the action more perfect and adjustable.

3041. Improvements in Apparatus for Producing and Directing Electric Currents, and for Applying them to the Steering of Vessels.—*C. G. Gumpel.—Dated 24th July*, 1880.

For producing electricity he constructs a dynamo-electric or a magneto-electric machine so as to obtain with a given velocity of the rotating armature more numerous and powerful currents in its coils than are usually produced, and to avoid heating the coils. Instead of diffusing the polarity of each magnetic field over a considerable part of the space through which the coil moves he concentrates the polarity as much as possible into a narrow field, and distributes an even number, preferably not less than four of such intensely polar fields, uniformly round the circumference of the circle in which the armature coils move, the polarity of these fields being alternated. The coils are wound on a rotating armature, which may be either a ring, as in the known Gramme machine, or a cylinder, as in the known Siemens machine; and the wires of these coils may be connected in any desired combination to insulated rings having brushes or rubbers bearing against them for the conduction of alternating currents, or they may be connected to insulated plates of a commutator. When a ring is employed to carry the coils the inventor sometimes constructs it of several parallel tyres of wood or other non-magnetic material, on which is fixed a sheet-iron casing, or iron wire or hoop is wound thereon, or on which are fixed, parallel to the axis of rotation, bars of iron side by side, but not in magnetic contact with each other. When the brush or collector has to extend over an arc of the periphery of some extent, he uses, instead of the sliding wires, thin plates fitted side by side in the casing, so that they can slide freely, being pressed by springs against the periphery of the commutator which their edges are hollowed to fit. To convert quantity currents into intermittent currents of high intensity by means of an inductor; instead of winding the wires of such inductors in the usual way, that is to say, with the secondary coil superposed on the primary coil, he winds these coils together, that is to say, the primary wire of considerable sectional area along with a number of secondary wires of smaller area, thus obtaining a juxtaposition throughout the coil of the secondary and primary wires, and bringing most of the secondary coils nearer to the core. For steering vessels he arranges the machines as follows:—In the engine room is a dynamo-electric or a magneto-electric machine, which may be driven by the engines or by a special engine for the production of a continuous electric current; as near as possible to the rudder is an electro-dynamic machine, which is moved by electric currents transmitted to its coils. This machine is connected to the rudder by suitable gearing, so that according as the armature of the machine is caused to revolve in the one direction or the other, the rudder is moved by it to port or to starboard, as the case may be.

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SLIP

SPAIN.—The prohibition of code or cypher messages to this country has now been removed.

PROPOSED NEW CABLE.—It is proposed to lay a telegraph cable from British Columbia to Japan.

ROYAL INSTITUTION.—Mr. Shelford Bidwell described his photophonic researches at this institution last night.

THE CROMPTON LIGHT AT GLASGOW.—Two more of these lights are, we believe, about to be erected in George-square, Glasgow.

UNDERGROUND WIRES FOR NEW YORK.—The Bill about to be introduced provides that after July 1st, 1882, all wires, telegraph, telephone, or otherwise, shall be laid underground.

THE EXHIBITION AT PARIS.—The Council of the Society of Telegraph Engineers has nominated a committee which will give every information relating to the forthcoming Electrical Exhibition at Paris.

TELEPHHONE IN PHILADELPHIA.—Permission has been granted to the Bell Telephone Company to erect poles in this city, providing the company place their wires underground when the system is a success.

NEW TELEGRAPH LINE.—The section of the Mexican Telegraph Company's line from Tampico to Vera Cruz is completed, so that the latter place is now in communication with the American land lines.

GLASGOW AND TELEPHONE WIRES.—The Town Council have refused permission for the erection of telephone poles to Messrs. D. and G. Graham, they being of opinion that the wires should be laid underground.

ITALIAN TELEGRAPH RECEIPTS.—The amount received under the head of telegraphs for the year 1880 was 10,136,790 francs, as compared with 9,184,761 francs in 1879, or an increase of 952,029 francs.

INCORPORATION OF CABLE COMPANIES.—The House of Commons of the Dominion of Canada have passed the second reading of the Bill to incorporate the European, American, and Canadian Cable Company.

AN ELECTRICAL SOCIETY FOR NEW YORK.—The *Operator* says that "a project is on foot to start the above, and is being heartily taken up, several promises of donations of books to form a library having been already made."

TELEPHONE AT DERBY.—Telephonic communication has been established between the central station of the Derby borough police and the divisional station at Litchurch, about a mile and a quarter distant. The Gower-Bell telephone is used.

DIVIDENDS.—The German Union Telegraph Company of Berlin (Vereinigte Deutsche Telegraphen-gesellschaft) have resolved to pay a dividend of 10 per cent. for the year 1880. The ordinary general meeting of shareholders will be held on the 19th inst.

ATLANTIC TELEGRAPHS.—The shares of these companies receded on Friday week on the news that the American Court had declined to grant the injunction sought by the Direct Cable Company against the consolidation of the American land line companies.

TELEPHONE AT IPSWICH.—Permission has just been granted to Messrs. E. R. and F. Turner to establish telephonic communication between their foundry and a branch office. The wires are overhead. Messrs. Ransome of the same town have the telephone in use at their works.

POSTMASTERSHIP OF BIRMINGHAM.—Mr. R. W. Johnston, formerly Controller of Special Telegraph Arrangements, and Supervisor of Postal Telegraph Schools, who succeeded Mr. Salisbury as Postmaster of the Eastern Central District, is about to be appointed to the vacant postmastership of Birmingham.

A NEW ELECTRICAL CONTEMPORARY.—The first issue is announced for the 15th of this month of *L'Electricien*, under the direction of MM. Vignes and Cyon. It will be published by M. Masson, of Paris. Our contemporary, *L'Electricité*, points out that the above title clashes with our own, which is unfortunate.

BETTER THAN LAND LEAGUE MEETINGS.—Mr. J. R. Holmes, of London, formerly engineer of the Orkney and Shetland telegraphs, recently lectured on electricity and its applications at Ballymena, near Belfast. We venture to think that this is better food for the multitude than they have been accustomed to of late.

SWISS BUDGET.—The amount of the receipts in the Telegraph Department for 1879 reached 2,076,492 francs, the expenses under the same head being, 1,631,572; for 1880 the receipts were estimated at 2,060,000 and the expenses at 1,879,000 francs; whilst for 1881 they are put at 2,250,000 and 1,901,354 francs respectively.

PRICES.—The price of gutta percha as quoted is, per lb., for genuine 4d. to 3s. 3d., reboiled 3d. to 1s. 3d.; and for india rubber, per lb., for Para (fine) 3s. 4d., negrohead 2s. 3d., Central American 1s. 10d. to 2s. 4d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d.

THE ROYAL SOCIETY.—Mr. W. H. Preece on Thursday, March 10, presented a paper to the Royal Society "On the Conversion of Radiant Energy into Sonorous Vibrations." This paper deals with, and the author believes has solved, the remaining problems connected with Bell's interesting discovery. We hope to be able to give the paper in full in our next issue.

MR. SAWYER ON ELECTRIC LIGHTING.—This well-known American electrician has just written a book on "Electric Lighting by Incandescence, and its Application to Interior Illumination," which is published by Mr. D. Van Nostrand, of New York. Mr. Sawyer is familiar to most electricians as an inventor of an incandescent lamp, and what he has to say is, therefore, interesting.

TAMPERING WITH FIRE ALARMS.—Sir Robert Carden lately inflicted a fine of £5 on a music teacher of the name of Walter Hammond for smashing the glass of a fire alarm when drunk, and so causing a false call, in answer to which an engine went out. We hope that after this wholesome lesson inebriate, or other foolish persons, will refrain from meddling with these useful alarms.

BANGOR NORMAL COLLEGE.—The results of the certificate examination at Christmas at this school show that the students take a great interest in electricity and magnetism. Of those presented in these two subjects over 59 per cent. have been placed in the first class, whilst of those presented by the whole number of training colleges in the United Kingdom only 19 per cent. obtained first classes.

A NEW CABLE WANTED AT ORKNEY.—The cable between Orkney and Shetland is in a faulty condition and communication intermittent. It is stated that one of the cables between two of the north isles of Orkney is so far gone that regular communication will not be established until a steamer is sent down by Government to lift and relay it, while it is probable new cables will be needed.

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American Opposition to Monopoly.—We understand the leading produce exchanges of Chicago have issued a circular to the principal members asking them to join in a combination to oppose the gigantic monopoly of the telegraphic system in America. The capital asked for is £2,000,000, with which it is assumed that all the necessary arrangements can be made for fair competition.

A Walking Magnet.—The Minneapolis *Tribune* is responsible for the statement that there is a boy living at St. Paul's, in that State, whose left hand is a strong magnet, so that knives, needles, pins, &c., adhere strongly to it. When heavy articles are placed on it he complains of pains in his arm. His arm and the left side exert magnetic power, but in a less degree, and there is none evidenced on his right side.

Iridium for Electric Light Burners.—An American claims to have discovered a flux by which iridium may be fused in an ordinary draught furnace. The discoverer is a Mr. Holland, gold pen maker, of Cincinnati. The metal can only be cut by friction with a copper wheel charged with diamond dust or fine corundum. The cast iridium is said to make good burners for the electric light, and to be durable without protection from the atmosphere.

The Telephone in America.—To show the progress made by this instrument on the other side of the Atlantic, the fact that Lowell in Massachusetts is telephonically connected with over one hundred cities and towns of that and other States is a good illustration. The longest circuit is over 150 miles, and works well. The Lowell District Telephone Company use 2,500 telephones, and pay the Bell Company a monthly royalty of over 1,200 dollars. They use more than 1,500 miles of wire.

Paris Telegraphs.—The total number of telegrams sent from one part of Paris to another last year was 969,177, and the amount paid for them was rather more than £23,000, nearly half of them having been transmitted by the pneumatic tubes. Since the charge for open telegrams has been reduced from 50 to 30 centimes, and for closed telegrams from 75 to 50 centimes, the numbers have gone up from 100,335 to 234,907 for open telegrams, and from 26,657 to 95,713 for closed telegrams.

Wasted Ingenuity.—A Leipzig professor is said to have devised a species of recording telephone, which will reproduce in "luminous characters" everything that falls from the lips of the person using it. The compulsory adoption of this contrivance would confer an immense boon upon Parliaments generally, our own, perhaps, in particular; but as exact reporting is the very thing that modern oratory would most dread, there is, we fear, not the least prospect of M. Gentilli's invention being even tolerated.

Chinese Telegraphy.—With reference to our recent Note under this heading we are informed by the Great Northern Telegraph Company, the contractors for the erection of the new line, that the contract further provides that a telegraph school for educating Chinese for the telegraph service in all its branches shall be opened shortly, under the guidance of two teachers nominated by the company. At the opening of the school there will be thirty pupils, which number will be increased gradually.

Electric Light in Surgery.—A Vienna doctor has just successfully operated on a patient for cancer of the stomach. The electric light was employed, and found of great assistance during the operation. A French doctor also finds it of great use for examining tissues, &c., in the body. The light is placed behind the part to be examined, and by using a tube of bright iron, 12 centimetres long by 10 and forty millimetres diameter, in the shape of a truncated cone, and looking through the large end, the tissues can be examined with ease.

Photographing Lightning.—A very distinct photograph of a lightning flash was taken by Mr. Crowe, of Liverpool, during the severe thunderstorm which visited that city on July 17, 1880. The camera was planted at a spot near Dingle, and directed to the sky over St. Philemon's Church, in Windsor-street. The flash, which has been made to photograph itself by its own light, appeared over the church at the instant the bell-tower was shattered to pieces. It exactly resembles the zig zag spark of an induction coil, and is estimated to have been about fifty-one inches broad.

Telegraph v. Telephone at Brighton.—The town surveyor having been directed to inquire as to the best means of connecting the fire-stations, police-offices, and waterworks, by telegraph or telephone, lately laid before the council the result of his inquiries, and recommended the use of the telegraph, expressing the opinion that telephones are not applicable with advantage where underground wires are running in conjunction with each other, and "are practically more liable to confusion and error in working than would appear at first sight." The committee adopted his suggestion.

Sunday Lecture by Professor Ayrton.—On Sunday last Professor Ayrton delivered a lecture at St. George's Hall, Langham-place, under the auspices of the Sunday Lecture Society. Mr. Ayrton took for his text "The Education of English Workmen." He insisted on the need of technical education, and showed the difference between it and popular lectures; he alluded to the City and Guilds Institute, and the good work it is doing, also to mechanics institutions and the future before them; finally, he took his hearers abroad, and described the various art and trade schools of France.

Electric Lighting in the City.—At a meeting of the City Commission of Sewers, at Guildhall, on Tuesday last, at which Mr. Ashby presided, the Streets Committee reported that the Electric and Magnetic Company (Jablochkoff system) had expressed their regret that, in consequence of legal and other difficulties, they were not in a position to seal the contract for the electric lighting of a portion of the City, in accordance with their tender of the 20th of October last. The committee had consequently made arrangements with the Electric Lighting and Power Generator Company (Lontin system) to light the district in question for a year at the same cost—£2,930. The district includes Southwark Bridge, Queen Victoria-street, Queen-street, and Queen-street-place.

An Electric Storm.—A severe snowstorm, accompanied by electrical disturbance and high wind, prevailed on the 6th January, over a space of 800 miles wide, along the line of the Union Pacific Railroad, between Omaho and Ogden. For 24 hours the telegraph wires were useless, the intensity of the electric storm being shown by the fact that when the telegraph key was opened by the operator, a steady electric light burned at the connecting points. The chief operator of the Union Pacific Telegraph lines has kept a record for years, and with but one exception in twelve years this storm occurred on the 5th, 6th, or 7th of January. It is believed that the entire Rocky Mountain region is visited by them.—*Scientific American.*

"Patience on a Monument."—The *Gas Journal*, speaking of Mr. Swan's light, says:—"Many irresponsible persons, upon seeing an electric light for the first time, at once jump

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to the conclusion that gas must go out of use on an early date; and this mistaken notion is sometimes fostered, for plain reasons, by persons who should be better informed. We, on the contrary, can await the inevitable course of events, without demanding the instant extinction of every electric light in the country—to copy the action of threatened vested interests in the dark ages. At the same time, and while freely confessing that the process of evolution must go on unhindered with advancing time, we may be pardoned for expressing, on this and all suitable occasions, the conviction that, for the present, gas lighting shows as much vitality as its younger rival. It is said that 'threatened men live long;' we believe that the truth of this aphorism will be borne out in the matter of domestic illumination."

Mr. Swan on his Lamps.—Mr. Swan lately gave a lecture to the members of the Leeds Philosophical and Literary Society on his light. He traced the history of electric lighting from the beginning of this century, and explained the different methods employed, until he came to his own invention. He said that "Improvements there would doubtless be; but in the meantime the lamp which he had explained, and which now shed its mild light upon his audience, would, he trusted, ere long find its way into their houses, and make them pleasanter and more healthful." The lecture was illustrated by several diagrams, showing the principle of converting motive power into electricity. A number of Mr. Swan's lamps were suspended from the ceiling of the hall. The light was worked by an engine of 6 horse-power, capable of 1,500 evolutions per minute, supplied by Messrs. Kitson of Leeds. Mr. Swan said that this was the first occasion upon which he had seen his lamps working from a special engine, and he had never seen the lights burn more steadily. This, he added, was entirely due to the perfect steadiness of the motion of the engine. Mr. Swan delivered a further lecture on Monday last at the Cleveland Institute of Engineers, at Middlesbrough. In the course of this address it was stated that the Swan light can be domestically employed at a cost of 25 per cent. below that of gas; that it was in every way desirable as a light for warehouses, shops, and in other extensive areas.

Cantor Lectures.—Professor W. G. Adams, F.R.S., gave to a very large audience the first of a series of lectures, in the lecture theatre of the Society of Arts, on Monday evening last, on the subject of "The Scientific Principles involved in Electric Lighting." This lecture dealt with the production and regulation of electric currents, and the mutual actions between electric currents and magnets. The lecturer commenced by referring to the fact that many brilliant discoveries were made before the world was ready for them, and hence the discoveries, and frequently the discoverers, were neglected. Ronalds, in 1816, showed that signals by means of electricity could be made at a distance, and if this discovery had been acted upon, with the impetus given by Oersted's discovery in 1820, we should have possessed electric telegraphs long before we did. Ronalds, years ago, spoke of electric conversation rooms, now actually seen in our telephone exchanges. The feature of the evening's lecture, however, was the description of Oersted's discoveries and Ampère's laws, illustrated by numerous experiments, attention being particularly directed to the fact that the inductive action of a magnet upon a wire is in exact accordance with the requirements of the law of "conservation of energy." It was experimentally shown that a current is generated in a coil revolved so as to cut the earth's magnetic field of force, except when the coil is parallel to the lines of force. The lecturer, in conclusion, said the ground passed over in this lecture had been elementary, but was nevertheless necessary for a right understanding of what was to follow.

Something Gone Wrong.—A Yankee Theory.—In view of the great extensions in telegraphy that are constantly taking place, an American paper seizes the opportunity to theorise on the subject and its connection with the atmospheric disturbances we have recently experienced in this planet. Here is what it says:—"Polarity depends upon a current of electricity passing at right angles to the direction of the poles. The polarity of the earth depends upon the electric or heat currents of the sun, and it is highly probable that the earth's inclination to the ecliptic is governed by its polarity. If, therefore, there were instantly established sufficient electrical connection by wires around the earth with the earth itself to instantly equalise the current and produce a complete reduction of all electrical excitement, what would be the effect on the polarity, and, secondly, on the inclination to the ecliptic? May there not be a sudden change of polarities—the Arctic region becoming equatorial and the tropics suddenly changed to polar temperature? The sudden melting of the vast ice-fields would produce another glacial flood, the present race would disappear, and man of the quaternary would begin life over again at the Antipodes. All this is to be accomplished by the continuation of complete circuits for telegraphing around the globe. Of course tremendous earthquakes would follow, as the polar diameter is twenty-six miles too short and the equatorial twenty-six miles too long. Whether this theory prove correct or not, there cannot be a doubt that something has of late gone wrong with atmospherical arrangements, and perhaps the telegraph wires are not wholly blameless in the matter."

Overhead or Underground Wires?—This question was considered at a recent meeting of the General Purposes Committee of the Manchester Corporation, when a letter was received from Mr. Fawcett, in answer to a memorial on the subject, in which he stated that "in the case of Manchester all the trunk wires of the Department are carried under ground, and that of the existing overhead wires only a comparatively small number belong to the Department, all of which have been substantially erected and are efficiently maintained. He would, however, be quite prepared to make arrangements for gradually placing these wires also underground if the Corporation should decide upon requiring the removal of the other wires referred to in the memorial. Only a few wires in the least busy districts would then be carried overhead. As regards the question of legislation for the protection of the public from the dangers pointed out as arising from the erection of wires by bodies or persons not authorised by special Act of Parliament, it did not appear to him that any fresh legislation was needed, inasmuch as these companies or persons, not being telegraph companies within the meaning of the Telegraph Act of 1863, are not authorised to place and maintain telegraphs along or across streets; and he added that an opinion had been given by the law officers of the Crown that the erection of poles and wires on public roads by persons or bodies not authorised by Act of Parliament is illegal, and that the parties are liable to be indicted for nuisance, even though the consent of the road trustees may have been previously obtained by them." It was recommended that a copy of this letter should be sent to any one whose telephonic or other wires crossed the streets, with an intimation that the corporation intended dealing with the subject, with the view of having all wires carried underground.

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THE TELEPHONIC SYSTEMS OF DR. C. HERZ.*

BY LE COMTE DU MONCEL.

(CONCLUDED FROM PAGE 193.)

On the 23rd June, 1880, M. Herz having requested my assistance in some experiments he was making, drew my attention to the fact that a small sized condenser, of the ordinary make, would, under certain conditions, reproduce speech. I thoroughly proved this fact, to my great surprise; when, however, I was shown that the transmitter was shunted, that this transmitter was identical with Fig. 1, and that it was excited by a very powerful battery I arrived at a solution of this phenomenon, but being bound to secresy on the subject I did not push my investi-

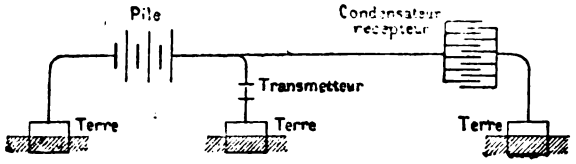

FIG. 7.

gations further, and, indeed, I had almost forgotten the method of conducting the experiments, when M. Dunand recently told me of his system of articulating condenser, in which he uses a second battery placed near the condenser in order to obtain constant polarisation. I then remembered that M. Herz used but one battery, and I thought I detected a difference between the two systems. However, on investigating the patents of M. Herz I found that, *owing to the shunting of the transmitter, the condenser used as a receiver always had the same potential as the battery, and that the action of the transmitter merely weakened this potential more or less at the moment of its action, so as to cause the condenser to repeat all the variations of resistance set up by the sonorous waves of the voice.* Fig. 7, taken from M. Herz's patent dated 9th June, shows the arrangement of the experiment.

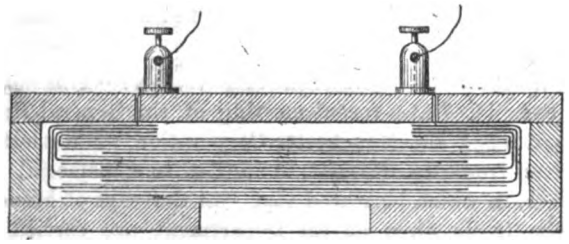

FIG. 8.

During the period in which I was present at the experiments the articulating condenser was always used, and it was some time before the best battery arrangement for loud speaking was ascertained. In the Brest-Penzance experiments it was tried with no great results, but it was otherwise in the experiments between Orleans and Bordeaux, and since that time it has been steadily improved upon for electrical combinations, and has been made to give excellent results over difficult circuits; but by using another transmitter, which we are unable at present to describe, and in which the electrical connections are unique and applicable to induced currents, still better results can be obtained. This discovery is the more important because, as we have already said, it has the advantage, by reason of the break in the line, of avoiding the accidental and abnormal currents which traverse every telegraph line. Fig. 8 shows this arrangement in section, whilst Fig. 9 gives us one of its many different forms.

During the above-mentioned experiments condensers of an electrostatic capacity of from five to ten microfarads and more were interposed, as well as the cards of points shown in Figs. 10 and 11, but the results were not as satisfactory as were anticipated, owing to the diminution which they caused in the intensity of the currents transmitted; nevertheless, it was possible to judge of the part they might be made to play in preventing the effects of accidental currents. However, with the previously-mentioned new transmitters, it is possible to considerably reduce the number of battery cells, and to do away with the shunts necessary for the apparatus in Fig. 1. Thus, in another way we obtain better effects. With this system, as we have said, speech can be heard, or at least detached phrases, over an enormous distance, 1,100 kilometres; but for this we require absolute silence. It has been found that with three Leclanché cells communication could easily be maintained between Paris, Tours, Poitiers, &c., at the same time that the other wires were in active use.

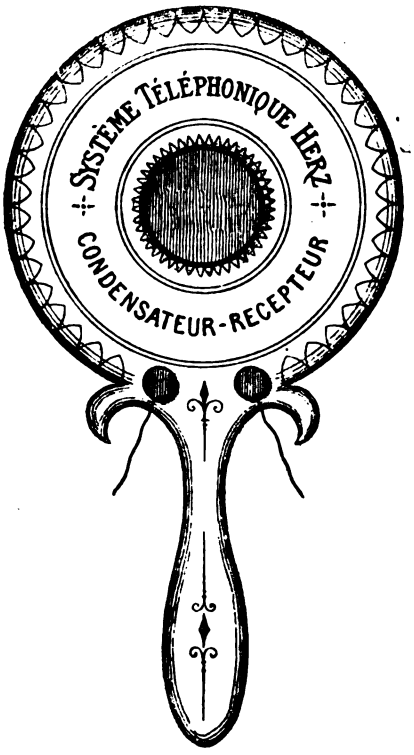

FIG. 9.

The multiple contact transmitter, without shunts to the battery, has been also tried with success, by connecting all the contacts directly with each other, and shunting them to earth, as in the other systems. It has always been necessary to use a strong battery of thirty-two cells, at the least. Sixty-four cells did not give a much better result. It has been found, however, that the

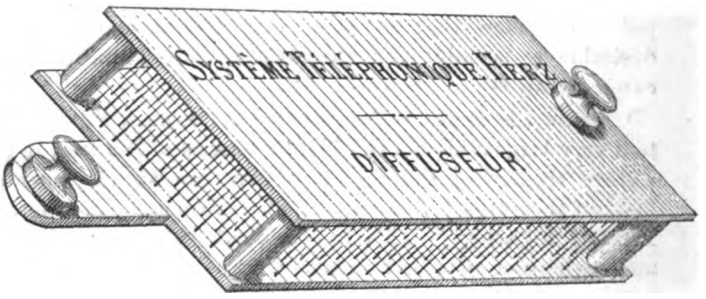

FIG. 10.

sounds are not so clear as with the arrangements before described. Different methods of grouping the transmitter contacts have also been tried. Thus, an experiment has been made with couples, so that every second one only is shunted to the battery, thus reducing the latter by one half. Good results have been obtained in this way, but not so good as with the other arrangement.

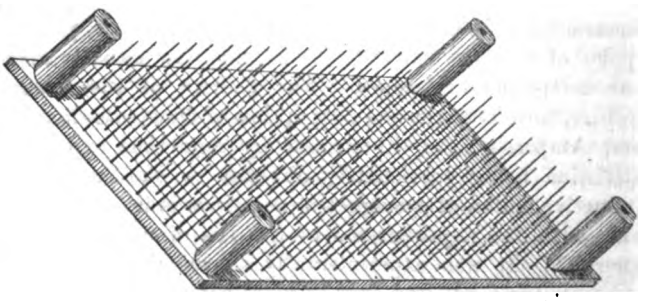

FIG. 1

The articulating condenser has been heard with ease between

* From *La Lumière Electrique.*

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Paris and Orleans and Paris and Tours. Indeed, in Paris itself, recent experiments have shown that the use of the articulating condenser offers great advantages to telephonic exchanges. We shall describe this system and the results obtained by it in another article.

Such are, then, the experiments made by M. Herz over the State telegraph lines during a period of three months; they are, as can be seen, very curious, and seem to finally solve the question of distant telephony. We regret that we are unable to describe the most recent system, which is very complete and practical, but we shall hope to do so as soon as the patent has been protected in the various countries.

THE ELECTRO-TECHNICAL SOCIETY OF BERLIN.

The first annual meeting of this society was held on the 25th February, under the presidency of Dr. Stephan, the German Postmaster-General. In reviewing the history of the past year, the chairman said that the society had been an extraordinary success, and had fully confirmed the belief of its founders that a desire existed for a central place of meeting for the various classes engaged in practical electricity. The number of members at the present time was 1,504, of whom only 328 belong to Berlin, while 956 reside in other parts of Germany and Austria, and 220 in other European States. From the report it appears that the income of the society last year amounted to 25,200 marks, or £1,260, while the expenditure had been 22,900 marks, or £1,145. The present president, Dr. Werner Siemens, having been re-elected to the same office for the coming year, Professor Förster read a paper "On Earth Currents." He alluded to the importance of a paper on this subject read at a previous meeting of the society by Herr Ludewig, who had described the earth currents observed at the time of the display of aurora borealis in August last. He thought that these observations were not only important additions to our knowledge of the physical condition of the earth itself, but were also of great value in certain astronomical problems. Dr. Förster pointed out that the closest relationship existed between the condition of the sun's surface on the one hand, and earth currents, the polar lights, and the variations in the phenomena of terrestral magnetism on the other. In this way he illustrated the importance of observing earth currents by means of telegraph wires. It had been demonstrated beyond all question that the particular condition of the sun's surface at any given moment stood in causal connection with the terrestrial phenomena above mentioned. The only question was, How? Dr. Förster proceeded to say that, between 1881 and 1883, it was confidently expected that we should witness one of those epochs, recurring every eleven years, when unusually violent phenomena of excitement are presented on the sun's surface. With a view, therefore, to securing exact observations he had already, in conjunction with a number of Swedish physicists familiar with this subject, drawn up a programme which he hoped the Society would assist in carrying out.—The president said that, in compliance with Dr. Förster's wishes, the German Imperial Telegraph Office would, as far as was compatible with the business of the service, gladly render all assistance in its power in carrying out Dr. Förster's programme, and co-operate in taking the desired observations.

ELECTRIC LIGHT COMPETITION AT GLASGOW. REPORT OF THE JURORS.

Report by the jurors appointed in connection with the Exhibition of the Philosophical Society of Glasgow, in 1880, of apparatus for the utilisation of gas electricity, &c., under section 1, "Electric Lighting Appliances."

The electric lights trial shown at the Exhibition were the following:—

First. Two Mackenzie patent lamps, worked one by a Gramme dynamo-electric machine, and the other by a Siemens machine, and both the machines driven by an Otto silent gas engine, exhibited by Messrs. P. Watt and Son, of Glasgow.

Second. Four Serrin-Lontin electric lamps, worked by a Lontin machine and divider, and exhibited by the Electric Generator and Light Company, London, through Messrs. Latimer Clark, Muirhead, and Co., London, their engineers. The Lontin machine was driven by a portable engine, lent for the purpose by the Executive Committee. During part of the time one of these electric lamps, placed on the top of the tower of the University Buildings, was lighted by a current from the Lontin machine in the Burnbank Hall, and this lamp was also shown as an occulting light, suitable for distinguishing lighthouses. The occulation was accomplished by making and breaking the circuit by means of a simple apparatus of Sir William Thomson's, and the lamp showed for the most part continuous light, interrupted at intervals of 15 seconds by a signal consisting of a Morse dash and dot. The arrangement was an impromptu one, made at the request of one of the committee, and carried out by Mr. Jolin, who was acting for Messrs. Latimer Clark, Muirhead, and Co., and as such proved admirably successful.

Third. The Electric Light system known as the Brush system, exhibited by the Anglo-American Electric Light Company (Limited). Their exhibit consisted of (1). A Brush machine and sixteen ordinary Brush lights, suitable to be worked in circuit by the same dynamo-machine. (2). A single small machine working a single light of power comparable with the single light exhibited by Mr. Crompton and by the Electric Generator and Light Company. (3). A small assistance Brush machine, and an electric light, which was called a 50,000 candle-power light.

Fourth. Mr. Crompton exhibited three Crompton lamps, worked by three Gramme machines, which were driven by a portable engine made by Messrs Marshall and Sons, of Gainsborough, and which is tested and reported on as a motor by the committee appointed for testing motors. Mr. Crompton's exhibit, as a whole, consisted of the portable engine, three Gramme dynamo-electric machines, three drums with 400 yards cable, three Crompton's patent six-hour lamps, three lanterns, two switches with variable resistance. The engine and the electric light are separately reported on, and as to the movable system, as a whole, the committee have to report that in their opinion it is very convenient and satisfactory, and easily applicable for lighting purposes.

The report as to the electric machines and lamps is given below.

Of the four systems exhibited, only two were finally offered for testing, namely, the "Crompton" system and the "Brush" system. At first it was proposed to offer the Lontin system in competition, but as the Electric Generator and Light Company were only exhibiting four lights instead of twelve, which ought to be worked by a single Lontin machine, it was pointed out that the trial would be very disadvantageous to them unless the work question could in their case be withdrawn, and the lighting power, &c., alone examined. The Electric Generator and Light Company were quite willing to submit their apparatus to this partial test, but it was objected to by Mr. Montgomery, the representative of the "Brush" system, and the Electric Generator and Light Company consequently withdrew from competition.

Mr. Crompton's dynamo electric machines and lamps were tested on Friday, October 29th, with the results given below, and it was arranged to test the "Brush" machine on Friday, November 5. The "Brush" machines were, however, withdrawn from competition by a letter received late on the night of Thursday, November 4, and by a telegram to their representative in Glasgow, Mr. Allen, on Friday morning, November 5, after the committee had at great labour and considerable expense made full preparation for an exhaustive test and measurement.

Mr. Crompton exhibited three "A" Gramme machines, made by Emmerson, Murgatroyd, Saulter, Lemonnier, and Mignon Rouart, called for convenience No. I. II. III., also lamps of his own invention.

As the Gramme machine is well known it is unnecessary to describe it here. The Crompton lamp is a modification of the well-known Serrin lamp, the alterations being addressed to simplifying the mechanism, and securing greater certainty and steadiness of light.

The resistances of the three machines were in ohms:—

	I.	II.	III.
Whole machine	0·997	1·078	1·077
Armature only	0·350	0·351	0·414

Three sets of quantitative determinations were simultaneously made on each machine; the power received by the machine, the current produced, and the brightness of the light in standard candles were respectively measured.

The determinations of power received were made by means of a dynamometer, which measured the difference of tension of the two parts of the driving strap. The instrument used was one which had previously been used by one of the jurors for similar experiments.

An account of it will be found in the minutes of proceedings of the Institution of Mechanical Engineers, April 1879.

The result in each case is calculated from the mean of many separate readings which agree remarkably well *inter se*:—

	Power absorbed in open circuit.	Power when giving Light.	Remarks.
No. I.	0·65	3·67	
No. II.	1·21	5·03	Strap too tight
No. III.	0·38	4·31	

The determinations of current passing were made with a Siemens electro-dynamometer. The mean results in Webers were:—

No. I. 29·56
No. II. 31·79
No. III. 34·59

The light produced was measured horizontally, and it is proper to remark that, with a continuous current, such as Mr. Crompton uses, the greatest intensity is directed about 60 deg. below the horizontal. The results obtained, therefore, by no means represent the full illuminating effect of the light as ordinarily employed. The results of the photometric observations of the electric lights which were tested on the 29th October are as follows:—

	Candles.
Murgatroyd machine 1st test	1903·5
Do. 2nd test	2,404
Saulter machine, 1st test	2,076
,, ,, 2nd ,,	1,855
Mignon Rouart machine	2,355

The Carcel lamp was calculated as being equal to 9·4 standard candles. Shoolbred states that it is equal to 9·5 candles, but that estimate is too high. All the tests were made by the Bunsen photometer as constructed by Sugg, but with the addition of stereoscopic lenses to the sight box, without which the photometric testing would be mere guess work.

The Carcel lamp was burning far too slow in the first test, and the result obtained should be rejected. All the others were good. Each test included 10 photometric observations.

As no dark chamber was at the disposal of the jurors, a number of screens of black velvet were constructed with apertures in their centres. These screens effectually excluded all stray light.

The following table gives a synoptic view of all the results obtained:—

(1) gives the whole power expended.

(2) the nett power—that is, the net difference between (1) and the power lost in friction,

(3) the currents generated.

(4) the light obtained.

	(1)	(2)	(3)	(4)
No. I.	3·67	3·02	29·56	2,154
,, II.	5·03	3·82	31·79	1,966
,, III.	4·30	3·93	34·59	2,355
Mean	4·34	3·59	31 96	2,158

The jurors remarked that the copper wire of the Gramme machines heated considerably, but not so much as to endanger insulation, and that the electric lamps gave a remarkably steady light. They would also express their appreciation of the readiness which Mr. Crompton showed to submit his machinery to any test the committee thought necessary.

(Signed) J. T. Bottomley (Convener),
William Thomson,
J. Hopkinson,
William Wallace

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TO OUR READERS.

For a long time past our space has been far too small for the amount of matter awaiting insertion, and arrangements are in progress to enable us to increase the size of the paper by several pages.

THE INTERNATIONAL EXHIBITION OF ELECTRICITY.

"The British Government, though declaring the full interest which it takes in the great scientific and industrial enterprise initiated by France, has decided that it sees no necessity for appointing a special commissioner to take measures with regard to the participation of British subjects in the International Exhibition of Electricity which is to open on the 1st of August next in the Champs Elysées Palace. The Government of the French Republic is nevertheless disposed to welcome all British subjects wishing to participate in the Exhibition."

Such is the gracious response of our neighbours to the churlish refusal of the British Government to expend anything beyond a few empty words upon the forthcoming Exhibition. M. Berger, the French Commissioner-General, addresses these words to intending exhibitors from this country, and desires it to be widely known that he places himself "unreservedly at their disposal, to give them every information, and to attend officially to their interests." After many other assurances of the courteous and impartial hospitality which will be extended to English exhibitors, M. Berger informs them that by special arrangements he has made with the French railway companies goods sent to the Exhibition will be brought back free of railway charges, and also that Custom House dues will not be levied except upon articles remaining in France. Several British subjects, it seems, have already applied for space in the Exhibition, and the Commissioner-General hopes that the "honourable example" of the British Postmaster-General, in availing himself of the authority of his Government to forward apparatus used by the Post Office, will be followed by all "the industrial electricians of the United Kingdom."

We sincerely hope it will; but left to themselves and the cold encouragement of their Government, we fear that the industrial electricians of this or any other country would be slow to enter into direct negotiations with the authorities in Paris, involving, as they necessarily would, much delay and a great deal of misunderstanding. Some local organisation is absolutely essential to a project of this kind, and our readers would be glad to see by the announcement we make on another page that the Society of Telegraph Engineers and Electricians has undertaken this important duty. The decision of the Government is the more humiliating by reason of the time it has taken to formulate its official pronouncement. The invitation might have been rejected months ago, on the plea that England deliberately prefers to have such matters left in the hands of private enterprise. But to ponder over it painfully and long, to allow other Governments to give in their unconditional adhesion, to be silent until silence was no longer possible, and then to tell the world that England cannot nationally join in a foreign Exhibition because England cannot afford it—this we say is as discreditable as it is inconvenient. Happily the reputation which England has won as foremost and greatest in the field of electrical science and telegraphic progress will suffer but little by the absence of Governmental patronage; and the worst perhaps that foreigners can say of us is that we, an enlightened and liberal people, are singular in being represented by a government that is neither one nor the other.

The delay, as we have just said, is very annoying; but if it has been the means of giving us the Society of Telegraph Engineers instead of South Kensington the loss of time is not wholly to be regretted. The Society at Westminster has shown itself capable of organising similar exhibitions on its own account on more than one occasion; it has recently added to its title so as to embrace the purely scientific members of the profession, and in every way this is the most unexceptionable body that could have taken the work in hand. It has been commendably prompt in its counterblast to the penny-wise trumpet of Lord R. Grosvenor, and we confidently hope that the louder call will meet with a cheerful response. M. Berger may without loss of dignity give credit to the British Government for its "full interest" in scientific and industrial enterprises; but before the month of August arrives we apprehend that the proof of real interest will be forthcoming, not from a British Government but from a British corporate profession, who will then have earned something more than the gratitude expressed in a mere polite phrase.

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CORRESPONDENCE.

SENSITIVENESS OF THE TELEPHONE.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The extreme sensitiveness of the telephone is now a subject almost beyond comment, but I have thought it of sufficient interest to send you an account of some investigations which I recently made on this subject.

There are two cables landing here, one from Vigo and the other from Lisbon, both of which were, unfortunately for us, broken at the same time, the former in Vigo Bay, the other about 735 miles from here.

Generally one or the other is always occupied, so that any experiments of this description are not possible, but being both idle, as well as our land line, I joined the two cables together here through a telephone. The other two ends being so far away I was curious to know what I should hear, and was very much surprised to hear Morse signals. After listening some time I found it was on the Brest cable of the new French Atlantic Company, their line running from Penzance to Brest (the cable lands about three-quarters of a mile from here), and their land line going to Penzance by a different route from this company's. So that with no earth connection here, and none on the other line except at Penzance and Brest, I could read the signals distinctly. No doubt it was by the induced current, but that it can be perceived at such a distance may suggest to some still further uses for this very delicate instrument.—Yours, &c.,

W. H. ASH.

Eastern Telegraph Company, Porthcurnow, Penzance.

INDUCTIVE ACTION OF MAGNETISM OF MINUTE PARTICLES OF STEEL AND IRON SUSPENDED IN A FLUID.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Minute articles suspended in fluids of various specific gravities are free to move and arrange themselves in obedience to the laws of magnetism and the colateral forces.

During repeated attempts to render the "magnetic field" in some way visible, a method of investigation presented itself which your readers may not have tried.

By employing a suitable menstruum, in which the particles are suspended, the effects of current and induction may be demonstrated. Very minute particles of steel and iron were placed in a flat-sided bottle containing lamp spirit; to the outside of this I applied the two poles of a permanent horse-shoe magnet. Immediately the inductive action became visible, and the direction of the current could be well seen by placing a lighted candle behind the bottle.

This is a convenient method of showing the exact extent of the "magnetic field," its form and *structure*, if I may use the term.

Nickel, cobalt, and other magnetic substances may also be tried in the same fluid, or separately, to compare the effects.

Photographs of different stages of the experiments would give permanent and exact records for comparison, the result of which would probably increase our knowledge in this very important branch of physics.

J. W. WETHERELL.

Sparnon, St. Buryan, Cornwall, March 5th, 1881.

ELECTRO-DYNAMOMETER FOR CURRENTS OF SMALL INTENSITY.*

BY MESSRS. SIEMENS AND HALSKE.

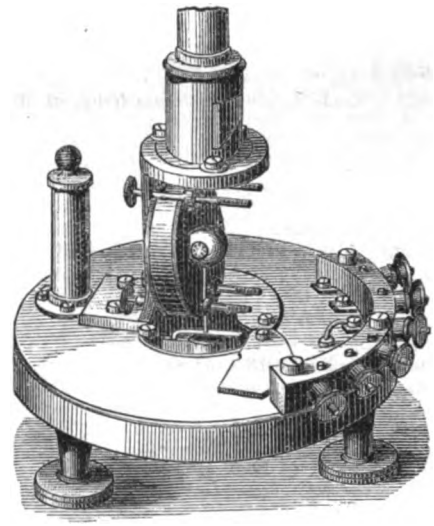
The new form of Weber's electro-dynamometer shown in the accompanying figure is a practical illustration of the principle enunciated by Dr. O. Frölich in the *Annalen Poggendorf*, vol. 143, p. 643.

We know that in the Weber electro-dynamometer the axis of the interior coil should be perpendicular to that of the outer one, and if the coils are of the ordinary cylindrical shape, the interior one should be small enough to be movable in the hollow of the other. Owing to this the space between the coils of the interior circuit and those of the exterior is rather large. To lessen this space as much as possible, Messrs. Siemens and Halske have made the interior coil and the outer portion of the exterior coil spherical in shape.

To increase the sensitiveness of the instrument the suspension of the interior coil, instead of being of bifilar construction, as is usual, is composed of a single conducting wire, by which the current enters: it leaves by a spirally-twisted platinum wire underneath. This wire, as well as the suspension, is ·04 mm. in diameter, and the suspension is fixed at its upper portion to an adjustable torsion screw.

Vibrations are avoided by means of mechanism. The movable coil carries at its lower end a rod furnished with two wings, which dip in a receptacle full of water fixed in the stand of the apparatus. This method of prevention renders it difficult sometimes to obtain zero; but this is overcome by making the parts of the wings which cut the surface of the water sharp like a knife. Arrangements are made to keep the level of the liquid constant.

In the axis of the interior coil, a small soft iron core may be introduced. This will nearly double the sensitiveness of the instruments, but the beats will no longer be quite proportional to the square of the intensity.



One of the two exterior coils may be taken out when we require to regulate the interior arrangements, or to put in, or take out the iron core. Usually the interior coil, as well as the two exterior ones, have a resistance of about 100 Siemens units, although the proportion between the resistances can be varied.

A mirror free to move in all directions is used to read by. The instrument can be arranged, so that the deflections may be shown by the ordinary method on a screen.

With the given resistance of the coils, and an exterior resistance of 20,000 Siemens units, the scale being two metres distant, one Voltaic element gives a beat of about 1 mm.

A horseshoe telephone, of the Siemens and Halske pattern, made to vibrate by a blast from a trumpet, gives a beat of about 5 mm., and by singing loudly measurable beats can be obtained with precision.

This instrument was employed in the winter of 1877-78 to study the electric waves in the underground cables of the German Telegraph administration.

*Translated from *Electrotechnische Zeitschrift*.

DYNAMO-ELECTRIC CURRENTS FOR TELEGRAPHY.

"On Some Experiments Instituted to Supply all the Lines Terminating at the Calcutta Telegraph Office with Currents Tapped from the Main Current Produced by a Dynamo-Electric Machine." Such is the title of a paper by Mr. Louis Schwendler in the *Proceedings of the Asiatic Society of Bengal* for November, 1880. The signal currents were produced by a dynamo machine at Howrah, and conveyed to Calcutta by an ordinary telegraph line two miles long. Altogether eleven main circuits were supplied with currents in this way, viz., the lines to Bombay, Madras, Kurrachee, and Rangoon. The currents sent from Calcutta and the currents received at the out stations were measured, and it was found that in all the lines, even the longest, the tapped or machine currrents were considerably stronger than those obtained by the ordinary signalling batteries. The experiment lasted for three hours, during which the ordinary traffic was despatched as usual. The main current at the commencement of the trial was produced through an iron wire of 21" diameter, with a resistance of 1·5 B.A. unit. This current was measured and found to equal 36,801 millicersteds (a millicersted = one milliweber per second, an œrsted being equal to one weber per second). At the end of the trial this main current was conveyed through the arc of an electric lamp, which gave a light equal to about 6,000 standard candles when measured under an angle of 45° with the horizon. In this case the current was equal to 45,706 millicersteds.

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The total current tapped from the main current (all eleven lines being simultaneously in use) equalled 129 milliœrsteds only.

Mr. Schwendler announced that this trial had proved so satisfactory and reliable that it was under consideration to introduce the system at the Calcutta Office; he also gave some suggestions for using the larger portion of the current not wanted for telegraph purposes. He thought that "the useful work for the main current at night would most conveniently take the shape of an electric light to illuminate the signal office. The electric light would produce at least fifty times less heat than if the same quantity of light were obtained by combustion; and this is, no doubt, a great advantage in a hot climate like that of India. During the daytime the main current might be used for pulling the punkhas, lifting messages, or, more generally, for working a pneumatic system of despatching messages between the head telegraph office and local centres in Calcutta. If Calcutta had the good fortune to possess a colder climate, it might be suggested to use the heat developed by the main current in a coil of iron wire for warming rooms. It would then only be necessary to lead the wires along the walls in a manner similar to that in which rooms are often heated by hot water pipes; only the electrical method would be far more economical. The quantity of heat given out by such a wire is by no means small. In one case it was equal to 20,473 ergs per second, equal to 488 grm.-degree-centigrade per second. This is about equal to the heat produced by an ordinary German stove consuming 6lbs. of coal per hour, supposing that the loss of heat when coals burn under a steam boiler is about four times greater than when they burn in a German stove. It appears, therefore, that the heat emanating from the wire should suffice to keep a moderate-sized and ordinarily ventilated room at a comfortable temperature, even when situated in the highest latitude.

THE ORIGIN OF ATMOSPHERIC ELECTRICITY.

Every new theory of atmospheric electricity is of interest, especially at the present time when the electric and magnetic properties of the earth are occupying the attention of as many physicists and electricians. We may therefore put before our readers the recent views of Professor H. S. Carhart of the United States on this important subject.

In an article in the *Popular Science Monthly* for February, Professor Carhart accounts for the phenomena of atmospheric electricity on the supposition that the earth is a charged body, acting inductively on the air with its clouds and vapours. Whenever moisture condenses to cloud, a better conductor is thereby formed, and increased inductive action takes place, causing an accumulation of electricity both in the cloud above and the earth beneath. If, then, the lower part of the cloud, under this inductive influence, condenses to rain and falls away from the upper part, a separation of the two electricities is effected, and an increase of potential results from the enlargement of the drops. Consequently, a discharge may then take place either between the upper and lower cloudy strata, or between the lower portion and the earth, according as one path or the other offers the least resistance.

Further, when evaporation takes place from an electrified locality, the rising vapour must carry away a charge of electricity by convection, as air and dust carry away electricity from a charged conductor. The condensation of this vapour increases its potential, and, if sufficiently rapid, gives rise to electrical displays. It is a fact of recent establishment that "northern lights" occur in various high latitudes only with southerly winds, which come laden with moisture and probably with electricity.

The following considerations in favour of Professor Carhart's view may be briefly enumerated:—

1. Continuous observations of the electrical state of the atmosphere at Kew Observatory and elsewhere for several years show that the air is always more or less electrified. The average potential of fair weather being + 4, it was found rarely to fall as low as + 1; often during sudden showers it equals ± 20 or ± 30; during snowstorms with high wind it sometimes reaches + 100; and during thundershowers ± 100 and even — 200. A predominance of negative electricity is characteristic of thunderstorms. Hence some origin of atmospheric electricity, always existing, but in different degrees of intensity, must be sought. Clearly, any form of energy connected with mere cloud-formation will not answer the requirements.

2. The observations show also that the potential of the air is exceedingly fluctuating, no natural phenomenon being comparable with it in changeableness except wind pressure. A change in the electrical state of the air indicates a corresponding state in the earth's surface. It is more reasonable to suppose that the earth, the great reservoir of electricity, should control the air and clouds electrically than that the clouds should control the earth.

3. The surface of the earth is, perhaps, never in electrical equilibrium; in other words, it is not an equipotential surface. Some time about 1865 Matteucci made prolonged experiments, and reached several interesting results. For instance, he found that a tolerably steady current of electricity flowed through a line established along a meridian, uniformly from south to north; that fluctuating currents of low electromotive force flowed through an east and west line, sometimes in one direction and sometimes in the other; that when one terminal of a long line was in a valley, and the other at a considerably higher elevation, a current flowed uniformly up the wire toward the more elevated end. A flash of lightning in this case was always accompanied by a sudden increase in the deflection of the galvanometer needle. (*Smithsonian Reports*, 1867.) (See also Mr. Adams's recent paper to the Society of Telegraph Engineers and Electricians.)

4. Irregular and spontaneous earth currents are the usual accompaniments of great terrestrial disturbances. James Graves showed in 1871 that spontaneous currents in the Atlantic cables frequently occur during earthquake shocks. (*Jo. Soc. Tel.*, ii., pp. 80-120). That spontaneous currents flow through land lines during auroral displays is a well-known fact. It is also asserted that any great meteorological change, on the motion of a heavy storm with considerable barometric fluctuation, is announced at a distance by irregular galvanic shocks through submarine cables.

5. Marked electrical disturbances in the atmosphere not unfrequently accompany earthquakes and volcanic eruptions. A vivid flash of lightning was seen during an earthquake shock in West Cumberland, England, on October 25, 1879. So frequently are these two phenomena conjoined that some writers have attributed South American earthquakes to electrical action. Lightning is often seen playing about the boundary between the condensing vapour from a volcano and the adjacent cool air.

6. Measurements of the potential of the air show that, as we proceed farther from the surface of the earth, the potential of points in the air differs more and more from that in the earth, the difference being approximately simply proportional to the distance. Also the electrical density is greater on projecting parts of the earth's surface than on those which are plane or concave. These facts are precisely what we should find to be the case in the vicinity of an irregular charged conductor, and they are sufficiently explained if we regard the earth itself as charged with electricity varying in density. In fact, observations of the potential of so-called atmospheric electricity are simply "determinations of the quantity of electricity residing on the earth's surface at the place of observation." (Professor Everett, in Deschanel's "Natural Philosophy.")

In the Rocky Mountains electrical storms are of frequent occurrence. They consist of electrical displays without precipitation of rain, hail, or snow. Usually, though not always, the sky is overcast. In February, 1880, a remarkable electric excitation was manifest at Boulder, Colorado. The miners were unable to kindle a fire in the stove till eleven o'clock in the morning, every attempt to touch the metal about the stove resulting in a severe electric shock. With every strong gust of wind the manifestations were more marked. Long's Peak, an isolated mountain 14,271 feet high, is noted for these peculiar electrical manifestations. The density of electricity on the peaks projecting so far above the general level of the earth's surface is greater than elsewhere; hence they possess a power to discharge like points on an electrified conductor. The air and aqueous vapour become surcharged with electricity, and only a slight condensation, sufficient merely to form clouds without rain, serves to produce discharges of lightning. With heavy gusts of wind the charged air is removed, and a fresh supply is provided, into which the peak again pours its electricity.

In view of these facts the theory is submitted by Professor Carhart that the earth itself is the seat of those disturbances that manifest themselves in atmospheric electricity. Fluctuating currents ebb and flow through the confining walls of this immense reservoir of cosmic energy. These follow naturally from the great changes in temperature to which the earth's crust is subjected; from those seismic disturbances occasioned by vast internal convulsions; from immeasurable local strain and compression, the result of upheaval and contraction. The earth, unlike the moon, contains still a vast store of unexpended energy; and in the ebb and flux of its mighty internal contending forces, and the bending and swaying of its magnetic lines of force, in obedience to the magic wand of the sun there is, in the opinion of Professor Carhart, ample room for the generation of these comparatively feeble forms of energy that manifest themselves in the electrical disturbances of the air.

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THE PRODUCTION OF ELECTRICITY.

This was the subject of a lecture delivered to a large audience by Professor W. E. Ayrton, at the London Institution, on the 3rd of March, and of which the following is an abstract:—After an apology for the compulsory postponement of the lecture from January, the lecturer referred to a passing remark of Dr. Lodge during a recent lecture—that electricity could not be produced. The answer to this was to produce it. The production of heat by friction, and the convertibility of heat into work were discussed, and Professor Ayrton, continuing, said: If I rub this piece of ebonite with flannel I certainly do work, and I also produce negative electricity in the ebonite and positive in the flannel, but the amount of work expended on the rubbing is not a measure of the quantities of electricity produced. In fact, as long as I keep the flannel and ebonite in contact, the electricities that have been produced in them are not manifested, and small bits of paper are not attracted. But, separate the ebonite and flannel, and at once the bits of paper are attracted by each substance. If the work expended in pulling up the bits of paper (for some work is required, though undoubtedly not much) is not the equivalent of the work expended on the original rubbing, how was the necessary energy produced? The answer is, in the separation of the flannel and the ebonite. Opposite electricities, as you know, attract one another, and it is the work performed in overcoming these attractions, while separating the flannel and ebonite, that is finally expended in picking up the bits of paper.

On turning the handle of this plate electrical machine, work is done, and as the visible result this little ball is made to spin. But the work necessary to make the ball spin is as nothing compared with that necessary to turn the electrical machine. The greater portion of the energy expended is wasted in heat, and only a small portion is usefully employed in separating the positive and negative electricities. The Holtz machine is designed to obviate this loss, and, consequently, infinitely more electricity may be produced with the same expenditure of power.

Any two dissimilar substances become electrified on contact. Nineteen hundred years ago amber was the only substance known that could be electrified. Three hundred years later another substance, supposed to be tourmaline, was added to amber; but it was not till a thousand years after the discovery of the electrification of amber that an Englishman (Dr. Gilbert) found that the property, so far from being confined to one or two substances, was comparatively common; and during the last half century—principally owing to the perfection of apparatus—our knowledge has so increased that the difficulty is to find a substance not already electrified by accidental contact with some dissimilar material.

To separate two substances that have been in contact work must be done. If the substances be insulators or be conductors, one or both of which is held by an insulating handle, the energy exerted is stored up in the charges of electricity in the two separate bodies. They have what is technically called potential energy, just as a reservoir of water on a hill has a store of power that can be utilised to turn water wheels. This potential energy can be utilised, and with an arrangement to make contact and separate a large number of times in succession we can get a nearly constant flow of electricity through the conducting wire connecting them, and thus have a simple means of converting power into electrical energy. (An apparatus designed by Drs. De la Rue and Hugo Muller for this purpose was shown.)

To produce an electric current work must be done; hence, by the principle of the conservation of energy, an electric current must itself be able to do work. (A magneto-electric machine, driving a lathe, was shown.) How is this electric current produced I have been using? When I separated the ebonite and flannel I did work, I exerted muscular energy, a small portion of food was consumed. Chemical energy, or the energy of combustion, was transformed into electric energy. (The action of a thermopile was shown, iron was burnt in oxygen, &c.) By means of a galvanic battery, instead of heat we obtain electric energy from the burning of zinc, and unlike the steam engine, where the greater part of the energy is not converted into work, the Dane, Julius Thomsen, has shown that in a Daniell battery all the chemical energy is converted into electrical energy. In a galvanic cell the contact of dissimilar substances produces the electricities, the chemical action separates them and produces the electric potential energy. For years an unnecessary contest has been carried on between the advocates of the contact and chemical theories, both theories being to a certain extent right, but alone being incomplete. Formerly we were not sure whether the E.M.F. between two dissimilar substances in contact, *i.e.*, the tendency they have to make electricity pass from one to the other, did or did not depend on what other substances were in contact with either. Consequently my colleague, Professor Perry, and myself, in Japan, carried out a long investigation to determine this point, the results of which I hope have done something in placing the chemical and contact theories on their present relative footing. The exact problem we set ourselves to solve was this:—In a galvanic cell there are a number of contacts of dissimilar substances. At each of these contacts solids with solids, liquids with liquids, and solids with liquids, there is probably an E.M.F. set up—then is the algebraic sum of these E.M.F.'s, each measured separately, equal to the E.M.F. of the complete cell? (An account of the lecturer's investigations on Contact Electricity was then given.) It was found that the separate E.M.F.'s were equal to the E.M.F. of the cell. It is now possible to predict the E.M.F. of a new cell constructed of any of the materials investigated in these experiments. (Professor Ayrton then referred to the chemical action in the cell, pointing out some objections raised by advocates of the chemical theory, explaining how difficult it was to obtain experimental data, yet holding out hopes of being able to overcome the difficulties, and stating that himself and Professor Perry were now carrying out a series of experiments with a view to solve the problem.) Professor Ayrton then said: I have said that a battery is a most efficient producer of power, by which I meant that nearly all the energy contained in the zinc that is consumed is converted into electric energy. Why, then, have all the companies for working lathes, sewing machines, &c., by electricity failed so miserably? Is it because the electromotor is less efficient than the steam engine? No, for while the very best steam engine can only convert 1-9th of the heat given off by the burnt coal into work, this magneto-electric machine, as actual experiments in my laboratory at Cowper-street have shown, can convert into work 8-9ths of the energy supplied to the electromotor. It is no fault, then, in the motor. But we must remember that it is not only necessary that our engine should be able to convert a large proportion of the energy contained in the fuel into mechanical work, but our fuel employed must itself contain much energy, and be cheap. Now, a pound of coal when burnt gives out about seven times as much heat as a pound of zinc; that is, the former contains seven times as much energy as the latter. But a pound of zinc costs about 2½d. when bought wholesale, and a pound of steam coal 1-12d., or a pound of zinc is about thirty times as dear as a pound of coal. If, then, our steam engine and our electromotor were equally efficient, work done by burning coal would be 210 times as cheap as work done by burning zinc. Since the electromotor is really eight times as efficient as the steam-engine, work done by burning coal in the furnace of a steam engine is about 27 times as cheap as work done by burning zinc in the battery of an electromotor.

The folly, then, of all electric power companies consisted in their attempt to do work economically by burning zinc. If we could devise a good galvanic battery for burning coal, steam engines would probably disappear. But, I hear you saying, is not a thermopile, such as we have on the table, a kind of galvanic battery for producing electric energy by burning coal? Undoubtedly it is, but, unfortunately, a most inefficient battery, and for a very simple reason, to which attention seems never to have been specially directed. Whenever an electric current flows through a conductor heat is produced and some energy is wasted; the greater the resistance of the conductor the greater the waste of energy. To obtain a considerable electromotive force with a thermopile the current has to flow through a long zig zag path, one side of which is kept hot and the other side cold. This path does not consist of a continuous strip of metal, but necessarily of a number of bits of metal joined together, and at each of the junctions there is some resistance or some loss of energy when the pile is new, and still more as it grows old. But the waste of heat by conduction, corresponding with the waste of heat through the sides of a boiler in a steam engine, takes place simply along any one of these bars of metal, and not along the zig zag, so that the more bars and junctions there are in the pile the greater is the waste of energy from electric resistance, and the greater the loss of heat by conduction, since the more paths are there for the heat to leak along, consequently, the more inefficient is the arrangement. All this is shortly expressed in technical language by saying that, whereas a thermopile, as made, is joined up in series for electric conduction, it is joined up in parallel circuit for heat conduction. The fact is, a thermopile has all the disadvantages, and even more than is possessed by a heat engine. In both heat is first produced from the fuel, and then this heat is converted into some other form of energy; whereas, in a battery, the potential energy contained in the fuel is at once converted into electric energy without passing through the intermediate stage of heat, and hence its great efficiency.

It was then shown that the electric motors were economical only under certain conditions, the most favourable being where natural sources of power existed, and where a number of interests were combined in the production of the power. The question that forces itself on all practical minds is, would the production of power in large quantities and the distribution among the combined interests pay? Professor Ayrton on this point said:—"I am going to show you an experiment which will enable any practical man, with no special knowledge about electric currents or electromotive force, to find out for himself the economy of the electric transmission of power."

Turning this handle drives a magneto-electric machine, but through what is called a "transmission dynamometer," that is an instrument for telling me how much force I am exerting. Observing, then, also the speed I can tell the power I am exerting, since one horse-power is, as you know, 33,000 foot pounds of work done each minute. At the other side of the room I have a motor which is worked by the current generated by this generator. Attached to the motor is an "absorption dynamometer," which tells me the work done by the motor. In this way, without any measurements of electric currents, or of electromotive forces, I can tell how much work is given out by the electromotor at the other side of the room for a certain amount of work put in the generator here.

The principle of a transmission dynamometer is this:—When a strap or belt is used, as is common in factories for communicating motion from one drum to another, one part of the strap is stretched more than the other, the tension in this part is greater than in the other, and this difference in tension is the force communicated by one drum to the other. We can measure each tension by allowing the strap to dip, or sag, by using a longer strap than is absolutely necessary to go round the drums, and by hanging a weighted movable pulley on each of the two portions of the strap the weight of which is supported by the tensions of the strap on each side of it, which are the same, although quite different from the tension on each side of the other movable pulley. Observing, then, the weight and the angle the strap makes with a vertical line through the pulley, a simple application of the triangle of forces gives us the tension, and the difference between the tensions at each of the movable pulleys is the force transmitted which we desire to know.

The simplest case is when pulleys are on the same shaft, one loose and one keyed, and the strap long enough to be vertical on each side of each pulley, as you see it in the apparatus before you, and enlarged on the diagram. In this case the force transmitted is simply half the difference of the weights hanging from the two pulleys.

This transmission dynamometer has one disadvantage—its liability to oscillate when in action, and for that reason a totally new form has been designed by Professor Perry and myself, the principle involved in which, however, I regret I cannot this evening describe, as it is not yet public property.

An "absorption dynamometer" is an instrument for converting the work given out by an engine into heat, and for measuring this work. If a cord be hanging over a wheel which is rotating, and a weight be suspended at each end of the cord, then the difference in the weights measures the force exerted by the wheel. This in pounds, multiplied by the circumferance of the wheel and the number of revolutions per minute, gives the number of foot pounds of work done per minute. The objections to this very simple form of dynamometer are, first, if the coefficient of friction between the cord and the rim of the wheel changes from drying by heating, &c., the cord and weights are thrown off; second, if the wheel on different occasions exerts different amounts of force, we must alter the weight in each scale pan to obtain a fresh balance. The absorption

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dynamometer I am using was devised by Carpentier. It overcomes both these difficulties by an automatic adjustment, by means of which the length of cord rubbing against the circumference of the revolving wheel increases as the coefficient diminishes, and *vice versâ*. If we wish the wheel to exert more or less force, the weight in *one only* of the scale pans need be altered, when the length of rubbing cord adjusts itself to the new condition of things. These results are attained thus:—On the revolving shaft is a loose pulley, to the circumference of which is hung a weight, A, tending to make the loose pulley turn in the direction opposite to that of the rotation of the shaft. Attached also to the rim of this loose pulley is an arm to which a cord is attached. This cord hangs over the rim of the revolving wheel, and a weight, B, attached to this cord pulls the loose pulley in the opposite direction to the weight A. The loose pulley is in equilibrium, then, under three forces, A pulling it one way, and B and the force x exerted by the revolving wheel in the other; x, then, is the difference between A and B. If the coefficient of friction increases so that x would become greater than A minus B, the loose pulley is rotated slightly in the direction of rotation of the shaft, less cord is now rubbing on the revolving wheel, and balance is again established. If, on the other hand, the coefficient of friction diminishes, the reverse takes place.

Now, experiments made by my students in my laboratory at Cowper-street in this way with magneto-electric machines, both as generator and motor, show that when the speed of both is high, and the load driven by the motor very light, the efficiency of the arrangement is about three-quarters, or even higher. We cannot expect to obtain as high an efficiency with ordinary dynamo machines without separate exciters, because to obtain great efficiency the current flowing through the wires connecting the two machines should be very small. But, if the main current is small, the field or exciting magnets will not be magnetised, and, under those circumstances, no work can be absorbed by the generator nor given out by the motor.

Up to the summer of 1879 a mistaken notion existed in the minds of even distinguished electrical engineers that there was a theoretical maximum of one half in the efficiency of electric transmission of power, and one of the most important points in my experimental lecture to the working men, given on the occasion of the British Association holding their meeting at Sheffield in that year, was the pointing out that this idea was wrong. One question only had been theoretically solved, viz., if we desire the motor to give out work most rapidly, what is the maximum efficiency? The answer is correctly one half. But there is another question, one of even more importance to engineers, viz., if we desire to transmit energy by electricity most economically, what is the maximum efficiency? It was this question that I on that occasion considered, and I stated at the time that Mr. Perry and myself had concluded from theoretical conclusions that the efficiency in this case could certainly be raised to three quarters, a result which has since been experimentally verified.

(TO BE CONTINUED.)

MONTEVIDEAN AND BRAZILIAN TELEGRAPH COMPANY (LIMITED).

The ordinary general meeting of the above Company was held at the offices, 9, King's Arms-yard, E.C., on the 10th inst., under the presidency of Sir Thomas Gore Browne, K.C.M.G., C.B.

The SECRETARY (Mr. James Fraser) read the notice convening the meeting, and the seal having been affixed to the register of shareholders, the directors' report for the year ending December 31st last was taken as read. It stated that the Company's percentage of the gross earnings of the Western and Brazilian Company amounted for that period to £3,256 17s. 11d., the December quarter being estimated at £850. After setting aside £500 for redemption of debentures, and providing for all charges and debenture interest accruing during the year, there remained a net balance of £1,491 13s. 5d., out of which it was proposed to pay a dividend of 3s. per share (£1 10s. per cent) and carry forward a balance of £244 11s. 5d. to next account.

On the motion of the CHAIRMAN, seconded by Lieut.-Colonel G. W. MACAULEY, the report was unanimously adopted.

The CHAIRMAN next moved the declaration of the dividend, as recommended, and

Dr. CAMERON, M.P., having seconded the motion, it was carried unanimously.

On the motion of Dr. CAMERON, M.P., seconded by Lieut.-Colonel MACAULEY, Sir T. G. Browne was declared a director; and the auditor, Mr. William S. Ogle, was reappointed on the motion of Mr. Potter.

The proceedings then terminated.

WESTERN AND BRAZILIAN COMPANY.—The traffic receipts for the week ending February 18 were £2,653, after deducting the fifth of the gross receipts payable to the Platino Company.

NEW ZEALAND TELEGRAPHS.—The statistics of this colony just to hand enable us to glance at the progress of the telegraph there. The figures are brought down to 1879. The first returns are for 1866, when the miles of line open amounted to 699, the number of messages 48,231, and the value of these to £9,114. Five years later, in 1870, the line mileage had increased to 1,887, the number of messages to 238,195, and their value to £27,422. From 1870 a steady increase is displayed. We give the figures for 1875 and 1879, which speak for themselves:—

	Miles of Line.	Number of Messages.	Value.
1875	3,156	993,323	£74,420
1879	3,512	1,448,943	112,351

TELEGRAPH SHARE LIST.

Companies.	Closing Prices March 9.		Business Done Week Ending March 9. Highest.	Lowest.
Anglo-American	58,	¼	58¼	57¾
Do. Preferred	86,	½	87	86
Do. Deferred	30¼,	⅜	30⅞	30
Brazil Submarine	10,	¼	10¼	10
Cuba	8½,	9½	9	9
Do. Preference	16½,	¾	—	—
Direct Spanish	3½,	4	3 9-16	3 9-16
Do. Preference	13,	¼	13⅛	13¼
Direct United States Cable	10¾,	11	11	10¾
Eastern Telegraph	9½,	¾	9 11-16	9 9-16
Do. 6 per Cent. Preference	12¾,	¼	12¾	12¼
Do. 5 per Cent. Debentures, 1899	102,	105	—	—
Eastern Extension	10,	¼	10⅛	10
German Union	10,	¼	10¼	10
Globe Telegraph and Trust Company	6 3-16,	5-16	6¼	6 5-16
Do. Preference	12 1-16,	3-16	12½	12
Great Northern	11,	⅛	11¼	11¼
Indo-European	26½,	27½	—	—
Mediterranean Extension	2½,	3	2½	2¾
Do. Preference	10,	¼	—	—
Reuter's	10¾,	11¼	10¾	10⅝
Submarine	270,	290	—	—
West India and Panama	1¾,	¼	1¼	1¼
Do. 1st Preference	6¾,	½	6 7-16	6¾
Western Brazilian	7¼,	⅜	7 5-16	7⅛
West. Union 7 per Cent. 1st Mortgage	122,	127	127½	126½
Do. 6 per Cent. Sterling Bonds	101,	104	102½	102½

TRAFFIC RECEIPTS FOR FEBRUARY, 1881.

Companies.	Feb., 1881.	Feb., 1880.	Increase.	Decrease
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,900 estd.	3,140	—	240
Direct Spanish Telegraph Company	1,876	—	—	—
Direct United States Telegraph Company	16,390	—	—	—
Eastern Telegraph Company	46,463	44,591	1,872	—
Eastern Extension Telegraph Company	28,021	25,190	2,831	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

ADDRESSES.

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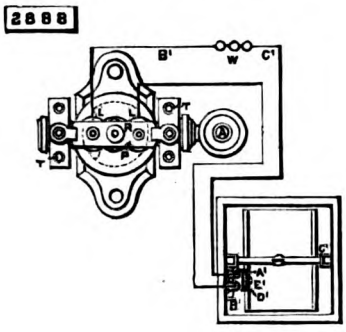
ABSTRACTS OF SPECIFICATIONS.

2888. SIGNALLING APPARATUS FOR MINES, *H. J. Haddan.—Dated 13th July*, 1880.—(*A communication from C. Cummings.*) 6*d*.

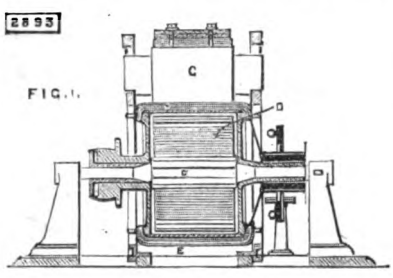
The invention consists in connecting a signal with the armature of an electro-magnet and placing the latter in an open electric circuit, which extends down a shaft, so that by closing said circuit at will the signal may be operated; also in extending electric conductors, respectively connected to opposite poles, down a shaft, and



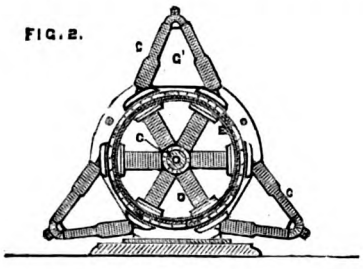
providing a cage with a device adapted at will to electrically connect said conductors during the travel or rest of the cage, thereby actuating an electro-magnet placed in circuit with said conductors, so that its armature operates a signal connected therewith, as shown in the figure.

2893. APPARATUS FOR GENERATING ELECTRIC CURRENTS, *Baron Elphinstone and C. W. Vincent.—Dated 13th July*, 1880. 8*d*.

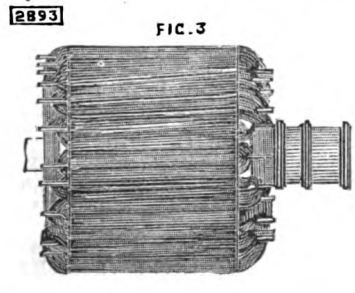
The invention relates to improvements in a dynamo machine previously patented. Steadiness and uniformity of action with the production when



required of alternating currents are the inventors' aims. The machine is so arranged that the follow-



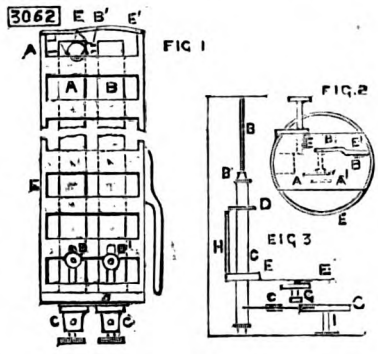
ing coils enter the magnetic field before the preceding coils have left. A definite current is sent



through coils. Figs. 1 and 2 show respectively a longitudinal and a transverse section of the machine, D D are stationary magnets bolted on shaft C; E is an armature; and G G the field magnets. The opposite poles of the internal and field magnets differ in sign. The heads of the armature drum consist of open discs cast with elongated hubs fitted into coned shoulders on shaft C. Hanks of insulated wire laid diagonally cover the periphery of the drum. The arrangement of wires of hanks to commutator is shown in Fig. 3.

3062. AUTOMATIC FIRE-ALARMS, *G. R. T. Brown.—Dated 24th July*, 1880.—(*A communication from F. Bogen.*) 6*d*.

The detector consists of two compound blades each blade is of two strips of metal soldered together; one blade is covered with a sheath of paper, the other left uncovered. The electric circuit is constant so long as the blades are of same length; but a sudden increase of heat acts more quickly on the uncovered blade than on



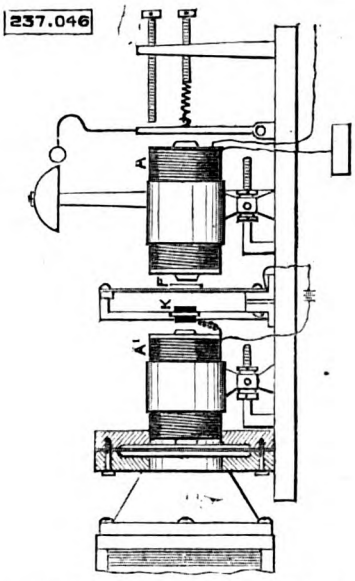
covered, making a break in the continuity of the circuit. The armature of an electro-magnet then comes into play and rings a bell. Fig. 1 and Fig. 2 show respectively a side view and a plan of the detector. Fig. 3 shows the bell circuit. If the increase of heat is gradual the blades expand similarly, and ultimately act against a fixed stop.

3041. APPARATUS FOR PRODUCING AND DIRECTING ELECTRIC CURRENTS, AND FOR APPLYING THEM TO STEERING VESSELS, *C. G. Gumpel.—Dated 24th July*, 1880.—(*Not proceeded with.*) 2*d*.

For producing the currents the inventor makes use of a dynamo or magneto-electric machine, constructed so as to obtain with a given velocity of the rotating armature more numerous and powerful currents than are usually obtained, and to avoid heating. He concentrates the polarity as much as possible into a narrow field, and distributes an even number, preferably four, of intensely polar fields uniformly round the circumference of the circle in which the armature coils move, the polarity being alternated. The coils are wound on a rotating armature similar to the ring and cylinder of the Gramme and Siemens machine. For steering vessels the machines are thus arranged:—The dynamo or magneto-electric machine in the engine room; as near as possible to the rudder, an electro-dynamic machine, moved by electric currents sent to its coils; this is connected to the rudder, so that according as the armature is revolved one way or the other, the rudder goes over to port or starboard.

237,046. TELEPHONIC RECEIVING APPARATUS, *Charles A. Randall, New York, N.Y.—Filed November 3rd*, 1880.

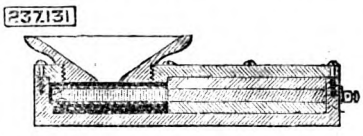
Claim.—(1) In a telephonic receiving apparatus the combination of an electro-magnet arranged for connection with a main line, a tension changer operated by said magnet, and arranged to control a local circuit including a receiver and a bell-ringing apparatus arranged for operation by said magnet, substantially as described. (2) The combination of the magnet is arranged for connection with a main line, the magnet A^1, included in a local circuit, a tension changer arranged for operation by magnet A, for varying the tension of said local circuit, and a receiver diaphragm arranged for operation by said magnet A^1, the said magnets, tension changer, and diaphragm being mounted upon a single base, substantially as described. (3) The combination of the adjustable magnet A, arranged for connection with a main line, the armature F, provided with a stud, the carbon block K, the adjustable magnet A^1, having one terminal of its helix connected with said block and the other with one pole of a local battery, the opposite pole of which is connected with the armature F of the magnet A, and a receiver diaphragm arranged for operation by said magnet A^1, substantially as described. (4) A magnet supported upon a pedestal provided with an opening or eye, in combination with a suitable supported screw extending through said opening or eye, and adjusting nuts arranged upon said screw for adjusting and securing said pedestal and mag-



net in position, substantially as described. (5) A carbon contact piece carried by an elastic non-metallic support, in combination with a movable pressure device arranged to act upon said carbon for controlling the flow of an electric current therethrough, substantially as and for the purpose set forth.

237,131. TRANSMITTING TELEPHONE, *Allen W Rose, New York, N.Y., assignor to Chas. A. Cheever, same place; said Cheever assignor to himself as trustee.—Filed October 26th*, 1880.

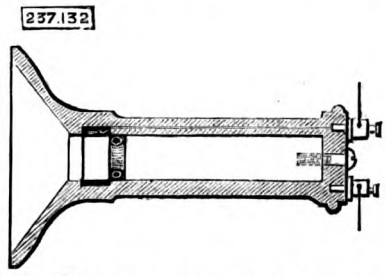
Claim.—(1) The combination, substantially as herein set forth, of two elastic or yielding diaphragms, constituting magnetic poles and included in a galvanic circuit, with metallic filings capable of magnetic or inductive action interposed loosely in the magnetic field between said diaphragms. (2) The combination, substantially



as herein set forth, of the case, the mouthpiece, the magnets, the interposed insulating material, the diaphragms constituting magnetic poles, the filings interposed in the magnetic field between said diaphragms in a loose condition, and a galvanic circuit, of which the filings form a part.

237,132. ELECTRICAL TELEPHONE, *Allen W. Rose, New York, N.Y., assignor to Chas. A. Cheever, same place; said Cheever assignor to himself as trustee.—Filed October 26th*, 1880.

Claim.—The combination, substantially as herein set forth, of the case, the magnet, the plunger, the interposed buffers or sustaining springs, and



metallic filings susceptible to inductive or magnetic action in a magnetic field, and constituting part of a galvanic circuit.

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SLIP

THE SOCIETY OF TELEGRAPH ENGINEERS.—At the next meeting, on the 24th inst., a paper by Mr. Morris will be read on "Japanese Telegraphs."

ACCIDENT BY LIGHTNING.—A man was struck at Hachesston, near Ipswich, recently, and the side of his body blackened. He is stated, however, to be recovering.

MERITENS MACHINE.—M. Meritens is engaged in the construction of a machine for Mr. Spottiswoode, specially designed for experiments with an induction coil.

THE POSTMASTERSHIP OF BIRMINGHAM.—Mr. Walliker, the postmaster of Hull, has obtained this appointment, not Mr. R. W. Johnston, as announced in our last issue.

CHESS BY TELEGRAPH.—The telegraphic match between the Liverpool Chess Club and Calcutta has been concluded in favour of the former. It has occupied a little over four months.

THE POST OFFICE AND THE TELEPHONE COMPANIES.—We understand that an agreement has been arrived at between these parties on the basis of a payment of ten per cent. of the receipts of the companies as royalty to the Postmaster-General.

MR. SWAN'S LIGHT.—Mr. Swan was to read his promised paper before the Glasgow Philosophical Society on Wednesday evening last. It was apprehended that the place of meeting would not be large enough, so great is the interest taken in the Swan lamp.

COMPAGNIE FRANCAISE DU TELEGRAPHE DE PARIS A NEW YORK.—Notice is given that this Company's Brest-St. Pierre cable is interrupted close to the latter place, and that the steamer "Pouyer-Quertier" leaves at once for the purpose of effecting the necessary repairs.

ROYAL SOCIETY.—On Thursday evening last Professors Reinold and Rucker presented a paper on "The Electrical Resistance of thin Liquid Films, with a Revision of Newton's Table of Colours," and Professor Hughes presented a paper on "Molecular Electro-Magnetic Induction."

SOCIETY OF ARTS.—On Thursday, March 24, Professor J. Perry is announced to read a paper on "The Future Development of Electrical Appliances," and on Wednesday, March 30, Mr. W. H. Preece is announced to read a paper on "Recent Advances in Electric Lighting."

EXPERIMENTS ON POLARISED METAL SURFACES.—M Lippmann has recently made experiments to ascertain whether a change in the optical properties of a metallic surface when polarised by a feeble current does not take place, which is invisible to ordinary sight. The results were negative.

PRICES.—The following are the prices as quoted :—For gutta percha per lb., genuine 4d. to 3s. 3d., reboiled 3d. to 1s. 3d. For india rubber, per lb.: Para, fine, 3s. 7d., negrohead 2s. 5d., Central American 1s. 10d. to 2s. 4d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d.

ATLANTIC TELEGRAPHS.—"Another fall took place in Anglo-American Telegraph Stocks on fresh rumours as to a competing cable scheme. It is reported that the projectors intend to ask for £1,500,000 to submerge cables in the Atlantic and the Pacific, but we have not heard from what source the means to pay working expenses are to be derived." —*Daily Telegraph*, March 16.

ALTERATION OF CHARGES FOR TELEGRAMS TO SOUTH AFRICA.—The rate to Durban (*viâ* Malta), is now 8s. 9d. per word; for other places in Natal, 8s. 11d. To Cape Colony and the Transvaal by this route the rate is 9s. 1d. per word. By way of Turkey the rates are 9s. 9d.. 9s. 11d., and and 10s. 1d. per word respectively.

AUTHORITY OF A TELEGRAM.—A person arrested in Toronto for fraud and robbery on the authority of a telegram sent from this country has been discharged "pending the arrival of the warrant for his arrest." The discharged "person" has decided not to await the arrival of the warrant, but tenders his thanks to those other persons responsible for the uncertainty still attaching to the legal authority of a telegraph message.

TELEPHONE AT SHEFFIELD.—Sheffielders are going ahead. We hear that the Exchange intend to ask the Town Council to allow them to fix a microphone in the clock tower of the Town Hall, so that any subscriber may, on calling to the Central Office, have his wire switched to the Town Hall wire, and so hear the clock strike in his office any hour of the day. The number of messages last week was 4,202; corresponding week last year 381—increase 3,821.

SOMETHING FOR THE AMERICANS.—The celerity in switching, for which praise is given to the Glasgow Telephonic Exchange, is said to be in a measure due to the presence of mirrors in the panelling of the switch-boards, a device which effectually prevents the eyes of the young lady operators from wandering off the boards for more than two seconds together all the time they are on duty. Falling discs are consequently instantly seen and attended to.

ELECTRIC LIGHTING.—The Inman Steam Ship Company's ship, the City of Paris, having been fitted with new engines, will shortly commence running to New York. She has been fitted with the electric light in the steerage, the system employed being the same as that which has given so much satisfaction on the City of Berlin. The whole of the work has been furnished and set to work by the Electric Lighting Supply Company, under the superintendence of Mr. Killingworth Hedges, C.E.

THE BIRMINGHAM TELEGRAPH CLERKS.—In acknowledging a memorial for presentation to the Postmaster-General, signed by the Mayor of Birmingham, 50 members of the Town Council and Justices of the Peace, and 600 leading merchants, manufacturers, and professional gentlemen of the town, on behalf of the local telegraph clerks, Mr. Joseph Chamberlain promised to forward the same to the Postmaster-General recommending it to his careful and favourable consideration.

TO DEVELOP ELECTRIC POLARITY BY PRESSURE IN HEMIHEDRAL CRYSTALS.—Prepare a slice of the crystal with parallel faces at right angles to the hemihedral axis; then apply a leaf of tinfoil to each face, and connect the tinfoil with a Thomson electrometer. Whenever a non-conducting hemihedral crystal with inclined faces suffers contraction, electric polarity is developed; whenever it is dilated, electricity is also developed, but the polarity is reversed.—MM. P. and J. Curie, in *Comptes Rendus*.

THE TELEGRAPH CLERKS' AGITATION.—At noon on Tuesday last the Postmaster-General, with whom was the first and second secretaries of the Post Office and a number of divisional surveyors, received a deputation of delegates representing the telegraph clerks of the United Kingdom, to give them an opportunity of setting forth their grievances. The interview, which was private, lasted upwards of six

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hours. We understand that the result is deemed in the highest degree unsatisfactory by the clerks.

THE TELEPHONE AS A FIRE ALARM.—The extensive biscuit factory in Cleveland-street, Glasgow, belonging to Mr. John Walker, was burned to the ground on the night of the 28th February. When the fire was discovered, which unfortunately was not until it had gained a thorough hold of the building, information was conveyed to the Central Fire Brigade Station through the medium of Messrs. D. and G. Graham's Telephonic Exchange, to which Mr. Walker was a subscriber, and the engines were far on their way to the scene of disaster before any warning reached the fire station by the usual channels.

GAS V. ELECTRICITY.—In his inaugural address as President of the Manchester District Institution of Gas Engineers, Mr. Chew committed himself to the statement that he was quite convinced that the electric light would not supersede gas for domestic illumination, though it was well adapted for large spaces; and even here he thought that when the novelty had worn off gas would hold its own. He was far more afraid of American oil at 1s. a gallon than of Mr. Swan's or any other lamp. We hope, for Mr. Chew's sake, that this comfortable frame of mind may long be his, though we should not like to go bail for his peace in the next few years.

THE MICROPHONE AND FIREDAMP.—M. de Rossi has made several experiments with the microphone, which point to the conclusion that explosions of firedamp are preceded by slight micro-seismic undulations and subterranean noises too small to be detected by anything but the microphone, which records them with marked sensitiveness. He thinks that observatories should be established in the neighbourhood of collieries, and that the microseismograph and microphone should be employed to detect the collection of inflammable gas within the earth, so that by this means, in combination with the barometric indications, warning would be received of the approach of danger, and precautions taken.

A CURRENT BREAKER.—At the last meeting of the French Physical Society M. Marcel Deprez showed a breaker which interrupts the current at the precise moment when it obtains its maximum intensity. It is composed of a small rigid lever oscillating on an axis, and, unlike the ordinary trembler, guarded as much as possible from all vibration. The interruption is produced with a movement of 1-500th of a millimetre. The movement of the lever is very slight, and the number of interruptions considerably increased. Applied to an induction coil this breaker gives better results; moreover, the spark assumes the shape of the voltaic arc up to a certain length, after which it becomes disruptive.

SOLDERING BY ELECTRICITY.—A recent American patent is a soldering iron, formed of a handle through which two conductors pass, and project for some distance beyond; between the ends of these is fixed a piece of platinum, which becomes heated on the passage of the electric current. One of the conductors is separated near the upper end of the handle, and bridged by a button made partly of electrical conducting material and partly of insulating material, so that by turning the button the circuit may be completed or broken at will. Another device separates the two halves of the handle, and so the two conductors, by a spring, so that to complete the circuit it is only necessary to close the halves together.

INDEX OF REFRACTION OF EBONITE FOR LIGHT.—We believe that Professors Ayrton and Perry are carrying out a series of experiments to determine the index of refraction for light of ebonite. This substance is usually regarded as quite an opaque body. The first experiments show this index to be roughly 1·7, the square of which is 2·89. Direct experiment on specific inductive capacity of ebonite gives a result varying from about 2·2 to 3·5. Maxwell's electromagnet theory of light would make these values equal. There is no doubt these indefatigable workers mean to thoroughly test the claims of Maxwell's theory, and the final results of their investigation, whatever they may be, cannot fail to be extremely interesting.

ELECTRIC LIGHTING IN THE CITY.—A month's delay wil take place in the lighting of Southwark Bridge District, owing to the contract having changed hands. The "Electric Light and Power Generator Company" (Lontin system), which has succeeded the "Electric and Magnetic Company," will, it is expected, begin their experiment on the 1st May. The other two districts are to be lighted on the 1st April. The cost for the three districts will be £8,060, but the expense of gas lighting during the year will be saved. One of the tall standard lights—that close to the Mansion House—was illuminated on Monday last, and has been in use all the week for purposes, as is supposed, of giving light to the workmen laying down wires to the other standards. The effect is very striking.

THE ELECTRIC LIGHT AT CALCUTTA.—M. L. Schwendler has just issued a report on the electric light at the East Indian Railway Company's Station, Howrah (Calcutta). The conclusions he deduces from the results obtained in his experiments are: (1) That the electric light as applied at the Howrah Goods Shed is more economical than gas light, even if very little use is made of the electric light. That, of course, the electric light becomes rapidly cheaper as compared with gas light the more hours per month the electric light is used. (2) That it has been proved by practical trial, extending over several months, that the system can be worked to satisfaction by trained natives only. (3) That the electric light is certain in its action, and, under the conditions at Howrah, more convenient than gas light. (4) It can, therefore, be recommended to introduce this electric light systems more generally in Indian railway stations, and especially at once at those stations where it is possible to connect with it the introduction of water works.

MR. HERRING AND THE POST OFFICE.—Mr. Herring, with the coming into power of a new Administration, seized the opportunity of urging his claims for an impartial investigation of his apparatus, which was promised by the Post Office, but has not been carried out according to the terms agreed upon. His immediate object was to obtain action on a petition presented to Her Majesty the Queen, a very laudable object, and one which is necessary to us all. We certainly cannot understand why such a petition remains practically unanswered, or why Sir W. Harcourt "cannot interfere further in the matter." Such a petition contains either facts or fallacies; but whether one or the other should have attention and obtain a categorical answer. As the case now stands we must conclude that the right of petitioning, long looked upon as one of an Englishman's greatest privileges, is absolutely valueless, for what is the value of a petition if it is not to be considered?

INTERNATIONAL ELECTRICAL EXHIBITION.—We are asked to make known that, at the request of the Commissaire Général, the Society of Telegraph Engineers and of Electricians have undertaken to supply to and collect from intending British exhibitors applications for space at the forthcoming Exhibition. Forms of application and copies of the general rules can be obtained at the offices of the society, 4, Broad-sanctuary, Westminster, London, by letter, addressed

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to the secretary of the society, or by personal application, between the hours of eleven and five. The Prince of Wales is reported to have had an interview with M. Berger on the subject of the Exhibition. In addition to the commissioners already nominated by their various Governments whose name we have given, Norway has nominated M. Havald Asche, Chief of the Bureau of the Minister of Marine and Posts; the Netherlands, MM. Gerard Oyens, Bosschen, Collele, and Van Kerkivyck, Members of the Chamber of Deputies; and Sweden, M. C. A. Nystraem, Chief Engineer of Telegraphs.

Prevention of Endosmose.—Two methods of preventing this action in a two fluid cell are described by M. D'Arsonval in the *Comptes Rendus*. First for cells without a porous diaphragm. A layer of powdered copper sulphate is covered by a layer of animal charcoal, and the zinc and exciting liquid placed on the top of these layers, as in an ordinary Callaud element. The zinc will remain unaltered for any length of time as long as the circuit is not completed. The internal resistance of the cell is increased by the charcoal, but not more so than by the sand usually used. The second method is to use a depolarising liquid, which forms a precipitate with the exciting liquid. This precipitate soon forms an impermeable coating on the walls of the porous cell, which prevents the mixing of the liquids by diffusion. The precipitate must conduct electricity and be an electrolyte. An element formed of zinc in zinc chloride in the outer cell, and silver in silver nitrate in the porous cell, has an E.M.F. of 1·5 volt, and a very small resistance. A cheaper element, composed of zinc in zinc sulphate, with lead in lead nitrate, has an E.M.F. of ·6 — ·75 volt.

The Conservation of Energy.—In the *Proceedings of the American Academy of Arts and Sciences*, vol. xv., part 2, 1879-80, Mr. John Trowbridge illustrates the conservation of energy as follows:—Let an induction coil be set in action. In the circuit of the secondary coil place another coil of fine wire. Adjust the terminals of the induction coil so that the spark just passes, then place a core of iron or a bundle of iron wire in the coil which has been included in the secondary circuit. The spark instantly ceases to jump. A portion of the energy of the current in the secondary circuit has been consumed in magnetising and demagnetising the iron introduced into the additional coil. The work done in this way is capable of being measured. It is also evident that, when a number of telephones are in the same circuit, a part of the energy of the human voice is consumed at each telephone in heating the magnetic cores. In the same paper Mr. Trowbridge alludes to his researches as to how much of the work employed in driving dynamo-electric machines is consumed in heating the iron cores of the generator of electrical currents, and whether this loss of work should turn our attention to forms of generators in which this loss is obviated.

The Berlin Electric Railway.—The original electric railways, says the *Engineer*, which were tried as experiments at the Berlin and Dusseldorf Exhibitions in 1879 and 1880, were worked by locomotives whose mechanism resembled a fixed dynamo-electrical machine. The rails of the line and the wheels of the locomotive engine were made use of to conduct the current of electricity and produce the necessary motion. The second conductor, conveying the current produced by the stationary machine to the locomotive, was connected with a system of brushes attached to the locomotive. These brushes touched a high-edged rail running in the middle of the two other rails, and insulated from the ground by a longitudinal sleeper. In practice, however, it has been found that this arrangement is exposed to serious interruptions. The wet, snow, and mud which, according to the season, collect in the ordinary course of traffic upon the middle rail, interfere very seriously at times with its conductive capacity. It has accordingly been determined on the Berlin Electric Line to conduct the current by means of a copper wire properly insulated and attached to pillars erected alongside the line, the current being conducted from the copper wire to the locomotive by means of contact rollers. We may add that the gauge of this first electric line is one metre. Its length is 2,500 metres, or rather more than a mile and a half.

Cantor Lectures.—The second of the series of Cantor Lectures on "The Scientific Principles involved in Electric Lighting" was delivered by Professor W. G. Adams, on Monday, at the Society of Arts. Professor Adams commenced by recapitulating his remarks made in the first lecture on Ampère's theory. A series of admirable diagrams were then thrown on the screen to illustrate the direction of the lines of force under different conditions—such as from one pole of a magnet only, from a horse shoe magnet, from one wire through which a current was passing, from parallel wires, from four wires, &c. These illustrations were due to Professor Sylvanus Thomson. The lecturer briefly referred to the Duboscq lamp, used for the above purpose, as the electric lamp ordinarily used in laboratory work, the current for the lamp being preferably obtained from a battery of Grove cells. It was shown that by making the poles of other material not carbon, in some cases, as when silver was used, the arc could be considerably lengthened, and was more useful for certain purposes. It was explained that the current from a battery was fairly steady, but from a machine it fluctuated considerably; therefore, when machines were used it is necessary to have means of regulation either in the lamp itself or in the external circuit. Some forms of regulators used in the external circuit were described—that used by Siemens somewhat minutely; then the lecturer proceeded to discuss the question of work performed by a dynamo-machine. As we hope to give these lectures *in extenso*, we merely indicate their scope in the present Notes.

Polarisation and E.M.F.—M. Blondlot has made researches into the question of voltaic polarisation with reference to the capacity, *i.e.*, the relation between the quantity of electricity furnished by a battery to a voltameter, and the E.M.F. acquired by it. The question he set himself to solve was to determine the smallest quantity of electricity capable of giving to a voltameter a given E.M.F., below the limit of polarisation. He placed in circuit a battery, a mirror galvanometer, and the voltameter; he closed the circuit for a given time and measured the quantity of electricity by the deflection of the needle; he then began again, having quite depolarised the voltameter, and by varying the time of closing, the required weak E.M.F.'s were obtained by means of one sulphate of copper cell with shunts. The duration of the contacts was regulated by a heavy and long pendulum. By graphically representing the results of these experiments we have a curve from which we can deduce the desired quantity. M. Blondlot endeavoured to ascertain if there was any proportion between the charge and the E.M.F., as in a condenser, but found none. The relation between these two quantities is always more or less complete, represented by curves of varying form, according to the nature of the liquid, and according as polarisation takes place by oxygen or hydrogen. A very simple law results, if we compare the capacity of an electrode for the two kinds of polarisation; the initial capacity is independent of the kind of polarisation.

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THE PRODUCTION OF ELECTRICITY.

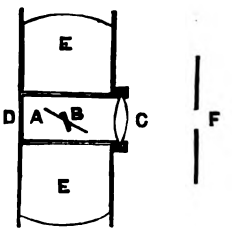
Continuation of Lecture delivered at the London Institution March 3rd by Professor Ayrton.

Seeing by Electricity.

We have seen how electric energy may be produced by contact, followed by mechanical separation, or by contact with chemical action, or by the relative motion of coils of wire and magnets. I now come to one of the most modern, and, perhaps, the most startling productions of electricity. In a thermopile we have a means for converting heat energy into electric energy, but with selenium we have the means, I have reason to think, of converting directly light energy into electric energy.

Some four years back there appeared in *Punch* a picture somewhat of the Corsican Brothers order. This picture, as far as I remember it, consisted of a lady sitting in her drawing room in England, and looking at the part of the room where one would expect to see the wall, but where instead she sees projected into space her daughters playing lawn-tennis in India. *Punch*, no doubt, regarded this picture as a sort of philosopher's dream; but it at once occurred to my colleague, Professor Perry, and myself, then n Japan, that we really had the means in our power of realising this dream. For, when a galvanic battery sends an electric current through a piece of selenium, the current, as was discovered by Mr. Willoughby Smith in 1873, is increased by allowing light to fall on the selenium, and the greater the intensity of the light the greater is the increase of current. This phenomenon is popularly attributed to a diminution of resistance of the selenium by light, but as Mr. Perry and myself have explained to the Physical Society, we have reasons for thinking that this curious effect may, perhaps, be due simply to a direct conversion of light energy into electric energy. However, be that as it may, I will now show you experimentally how Professor Perry and myself propose employing this property of selenium to enable us o "See by Electricity."

FIG. 1.

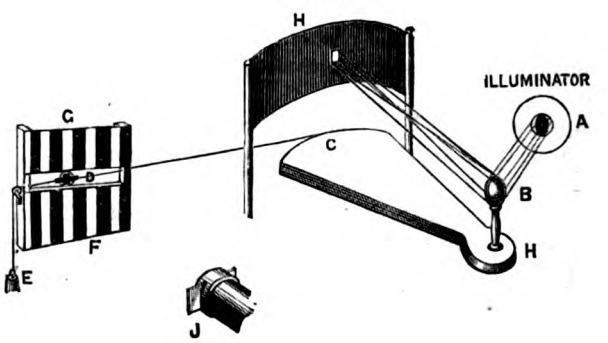


Suppose we in London wish to see some object at York, then this object, which may even be in motion, is brilliantly illuminated and an image of it projected on a screen, which in the most elementary form of our apparatus is made up of a number of distinct pieces of prepared selenium, selenium cells as they are not inappropriately called. From each of these pieces of selenium at York a wire goes to the "Illuminator" at London, shown in Fig. 1. F is a small screen with a square hole in it, illuminated by a lamp on the right hand side, and not shown in the figure. By means of the lens C an image of the hole in F is projected on a screen on the left hand side of Fig. 1, also not shown. E E is a coil of wire, such as is employed in a galvanometer, one end of which is connected with the insulated wire coming from one of the selenium cells at York, and the other end of which is to earth. At York a battery has one of its poles connected with the selenium cell, and the other end to earth. There is thus a current sent through the selenium cell at York and the coil of the Illuminator at London, the strength of which depends on the amount of light falling on the selenium. A is a blackened elliptic aluminium shutter, to which is attached a small magnet, B, making an angle of 67½ deg., and both are suspended by a silk fibre about 1-20 inch long inside the blackened tube, which is closed at one end with the piece of plate glass D, and at the other end with the lens C. When no light falls on the selenium at York a controlling magnet is so adjusted at London that the aluminium shutter A makes an angle of 45 deg. with the axis of the tube D C, and completely prevents all light from passing through the tube, and, on the other hand, when the selenium at York is well illuminated, the shutter A lies along the axis of the tube, and all the light passes through the tube; for all illuminations of the selenium between these two the shutter takes some intermediate position. Therefore the illumination of the square on the screen at London is an exact reproduction of the amount of light falling on the aluminium at York. And as this is true for every piece of selenium it follows that we shall see at London a picture in mosaics which is an exact representation of the illuminated object at York.

The particular shape of the aluminium shutter and the angle it makes with the tube have been selected so that a small angular motion greatly alters the amount of light falling on the screen, and so that the amount of light passing shall be nearly proportional to the angular motion. The particular angle made by the magnet with the shutter has been selected to enable the magnet to be always in the most sensitive portion of the magnetic field produced by the current passing through the coil E E.

So much for the crude idea; but it is possible to greatly simplify the construction, to diminish the cost, while at the same time to obtain even increased efficiency by utilising the physiological fact that an impression remains on the eye for about ⅛th of a second of time. Instead of the selenium cell being fixed at York, let it be in motion over the whole or a part of the image of the brilliantly illuminated object to be seen. In the actual apparatus before you I have projected on the screen F G (Fig. 2), supposed to be at York, an image of a grating put in the lantern J, that is, on the screen F G you see alternately vertical bright and dark bands. Now, the selenium cell D is, as you see, arranged to move through these dark and bright bands. Consequently, at London, we should see on the screen at H alternately a dark and a bright square. But in addition to this we have a mirror, B, so arranged that it turns with the table G H, on which it rests, round a vertical axis through the support of the mirror. In the apparatus before you this is done mechanically by connecting G to D with a cord, but in actual practice this result would be attained by having two clocks going synchronously controlled by an electric current. The consequence is that we not only see a bright square on the screen in London every time the selenium happens to be in one of the vertical bright bands at York, but in addition we see the bright square on that part of the screen in London which corresponds in position with the position of the bright band at York, in which the selenium at that moment happens to be. If, then, the selenium moves backwards and forwards with sufficient rapidity, we shall see on the screen A an image of the whole path through which D moves. And not only does the principle of motion simplify the cost of the apparatus, but it enables us to overcome the difficulty arising from abnormal variations of selenium, since such changes would, when motion is used, only tend to dull or to brighten a large portion of the picture instead of producing a single erroneous black or bright spot on one part of the picture, as would arise in the case of the selenium being at rest.

FIG. 2.



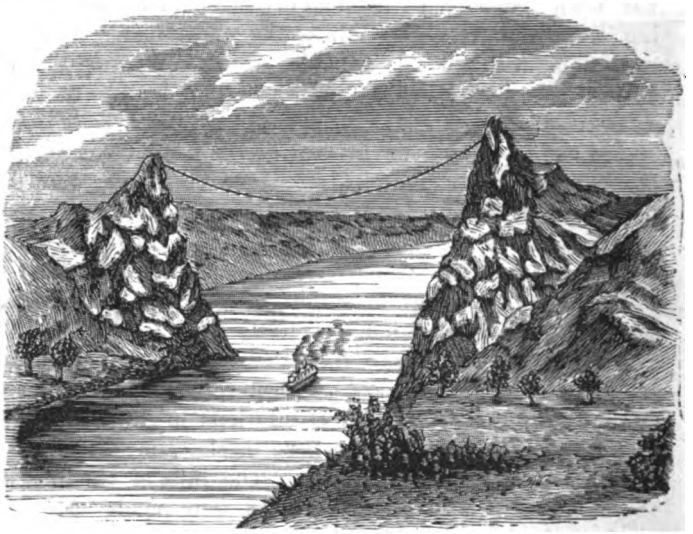
This apparatus of Professor Perry's and my own, the principle of which was described long before the photophone was heard of differs, be it remembered, altogether from the latter. The photophone is for "hearing by light," while our instrument is for "seeing by electricity."

The lecturer concluded by briefly referring to another promising illuminator he and Professor Perry were experimenting with, based on the changes produced on the image cast on the screen by a metallic mirror, when slight distortions are produced at different parts of the back of the mirror, the principle, in fact, on which, they had experimentally proved, depend the phenomena of the so-called Japanese magic mirror.

NOTES AND QUERIES.

Span of Wire.

We illustrate what is thought by a correspondent to be the longest span of telegraph wire in the world. The wire is stretched across the Kistnah river from hill to hill, each hill being 1,200 feet high, between Bezorah and Sectanagrum, in



India. The span is a little over 6,000 feet in length. The only mechanical contrivance used in stretching this cable across the river was a common windlass. Does any correspondent know of a longer span?

Outfit.

We have constant inquiries as to the outfit a man should obtain when sent to an extra-European station. Would some of our many readers at the cable stations favour us with a list of the outfit required for their particular station?

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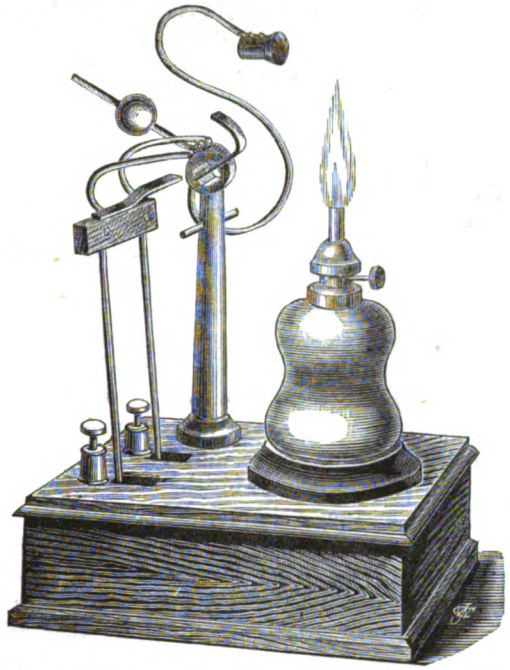
MAIGRET'S AND RANQUE'S LAMP LIGHTERS AND EXTINGUISHERS.

In M. Maigret's invention, a spirit or petroleum lamp is placed on a frame which encloses a horizontal electro-magnet, the armature of which carries two long copper rods, to the ends of which is affixed a small platinum wire. These rods act on a small bellows, to which is fixed a pipe, the end of which abuts on the flame of the lamp. An ordinary Leclanché battery of four cells, such as is used for electric bells, is enough to work the apparatus. To light the lamp, the current traverses the electro-magnet and the wire. This attracts the armature and causes the wire to approach the wick, which lights. In extinguishing it the same thing occurs, and the bellows blows the lamp out, the electrical contact not being long enough for the wire to have time to relight the lamp.



M. Paul Ranque's system (shown in our illustration) differs from M. Maigret's in detail only, the idea being the same. Instead of the bellows M. Ranque employs an ordinary extinguisher. To extinguish the lamp a current is sent through the electro-magnet as before, which acts on a small elastic strip of metal, mounted on the rods which carry the platinum wire. This acts on a second hook-shaped metal strip, which carries the extinguisher and lets it fall in the lamp. To light the lamp, the elastic metal strip passes under the hook-shaped metal strip, lifts it together with the extinguisher, whilst the platinum wire, being incandescent, approaches the wick and lights it.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

The usual fortnightly meeting of this society was held at the Institute of Civil Engineers on the 10th inst., Professor Foster, the president, in the chair.

Before resuming the discussion upon Mr. A. J. S. Adams's paper on "Earth Currents," the meeting was informed by the PRESIDENT that a committee had been constituted by the council of the Society to forward the interests of intending exhibitors at the Paris exhibition of electricity, and that this committee were now prepared to act as intermediary between British subjects and the French executive. It was no fault of the Society that the time was so short, for it had been hoped that the Government would take the matter in hand, and so long as its decision remained in uncertainty nobody else could presume to act. Professor Foster wished it to be widely known that the latest date up to which applications for space in the exhibition could be received was the 31st inst., and that short as was the interval at their disposal the committee hoped to be able to render substantial assistance and encouragement to applicants, so that Great Britain might be adequately represented in this great international competition of electrical engineers.

After some explanatory observations from Mr. WILLOUGHBY SMITH with reference to his experiments with a cable under the Thames, which were described in our report of the previous meeting, and which appear to have been made with a view of ascertaining the presence of induced currents rather than of earth currents, Mr. A. J. S. ADAMS proceeded to read his reply. On the whole he was well satisfied with the result of the discussion, which, though in some points adverse to the theory he had ventured to put forward, had not shaken his belief in the relationship between the phenomena of earth currents and lunar variations. No doubt there were solar variations that had to be taken account of, and there were special causes occasionally, and even periodically, producing special earth current effects; but these were not to be confounded with the normal, regular, and uniform effects with which he had been dealing; and it was worth noting that even the abnormal phenomena referred to in the course of the discussion never exceeded the normal effects by more than two to one. Sufficient attention had not been paid to the fact that his extended observations showed uniformly four maxima deflections and four zeros in the lunar day; and this would be found to be the case with all earth currents proper. Some of the cases cited by other observers were, therefore, not in this category, and required a different explanation; they certainly did not impeach the broad conclusion to be drawn from his own long series of observations. In confirmation Mr. ADAMS read an important communication from Mr. Graves, of Valentia, showing the records of earth currents on one of the cables in 1873, in which lunar progression was clearly indicated. Touching Professor Ayrton's explanation of earth current in wires crossing streams, Mr. ADAMS was understood to say that, although theoretically it might be true that a running stream cutting the lines of the earth's magnetic force would give rise to a current in a neighbouring wire, the variation described by Mr. Wollaston did not correspond with the variation which would result from action of that kind. He, Mr. Adams, had known an instance of a cable indicating current varying with the rise and fall of the tide, and even with great waves passing over the cable; but it turned out that there was a fault in the cable, which, being attached to a floating buoy, varied electrically with its motion. He intended to continue his observations, and at some future time would bring them before the society.

Professor FOSTER complimented and thanked Mr. Adams for his valuable paper. There were no doubt local as well as general causes to be taken into account in studying the phenomena of earth currents; and he trusted that one result of this discussion would be a more extended and more continuous observation of them in various parts of the world. Mr. W. H Preece was also thanked for his communication at the previous meeting.

Lieutenant P. CARDEW, R.E., then read a short paper suggesting the use of dynamo-electric currents as an auxiliary assistant of locomotive power, and especially for break purposes on railways. He thought that a dynamo machine on the engine, connected with the driving wheel, and electrically connected with receiving machines under each carriage, the brushes revolving with the wheels, might be worth a trial; and he diagramatically explained how the connections could be made so as to accomplish, theoretically at all events, the objects he contemplated. After some remarks from Mr. SPAGNOLETTI and Mr. ALEXANDER SIEMENS, who pointed out some practical difficulties, Mr. CROMPTON expressed a confident opinion that a break of this description was sure to be devised before very long; and considering how suggestive was the well-known "pulling-up" of the engine at the moment of attaching the dynamo machine for electric lighting purposes, the wonder was that such a break had not already been perfected. Mr. KEMP here interposed with what seemed to be a fatal objection to Lieutenant Cardew's suggestion, namely, that as the action of the dynamo machine depended upon the action of the steam locomotive, the electrical power would cease when the engine shut off steam—that is to say, just at the moment the auxiliary break power was most needed. This, however, was not considered fatal by Professor AYRTON, who explained that what was needed to stop a train was a check, or series of checks, not the skidding of the wheels. He thought that a magneto-electrical system would be preferable, however, to the dynamo-electrical system suggested by Lieutenant Cardew.

Mr. E. B. BRIGHT then described his method of dispersing the electricity generated on wool, mohair, and alpacca yarns in the course of manufacture. The friction which the filaments undergo during the process of preparation for, and being wound upon, the bobbins, generates electricity in such a marked and obstinate way that each thread is found to be bristling with spikey hairs, more or less rigid, which, in the mass prove to be so refractory that the weaving operations have to be delayed sometimes for months before the yarn is in its fit condition to be made up into fabric. The phenomena here described is called "stickleback" in the trade, the cause of it never having been conjectured until recently, and then—as was subsequently stated by Mr. W. H. Preece—by someone not connected with the manufacture, a Mr. Gilpin of the Postal Telegraph service at Bradford, who appears to have communicated the idea of an electrical cause to Mr. Bright. It has been the practice of the manufacturers to store away the "sticklebacked" yarn in damp cellars for long periods, accident having revealed the fact that the bobbins so treated gradually recovered their normal condition. Chemicals had also been tried to get rid of the inconvenience; but all these devices were liable to create mildew or injury to the dying process later on, and in any case the delay was often the cause of very serious pecuniary loss. Setting himself to the somewhat unusual task of getting rid of electricity where it clearly was not wanted his first thought was to put the yarn in connection through the machinery with good earth; but the hairs being hollow and electrified inside as well as outside, the charge, Mr. Bright thought, could not be got rid of in that way—at all events that way did not prove successful. He then hit upon the plan of enclosing the bobbins in rarified air, which is known to be a fairly good conductor, and this method answered his expectations thoroughly. Remaining a few minutes within an exhausted receiver the yarn is in a better condition than formerly it was after storing in a moist atmosphere for several months. Mr. Bright anticipated from this method that not only will there be a great saving of time, but that much finer yarn may be worked into fabric now that he has removed the otherwise common danger of breakage when encumbered with "stickleback." Practical illustration of the process was exhibited before the meeting by means of an electrical machine and an air pump. Charged filaments were placed under the receiver, which was joined to earth and the air exhausted, whereupon the fretful tuft of alpacca gradually collapsed, and resumed its natural limpness. To accomplish this object on a large scale, Mr. Bright constructs an iron chamber, into which the bobbins are carried on small trucks; the door is then closed, and air-pumping gear connected with the machinery of the factory is set to work. An electroscope attached to the exterior of the chamber indicates when the discharge is complete; air is then let in, the door opened, and the yarn removed to make way for another truckload. Mr. Bright's paper was received with marked attention, and the customary vote of thanks was accorded with unusual warmth.

The next meeting was announced for the 24th inst.

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TO OUR READERS.

For a long time past our space has been far too small for the amount of matter awaiting insertion, and arrangements are in progress to enable us to increase the size of the paper by several pages.

PUBLIC INTEREST IN ELECTRICAL PROGRESS.

It is curious to notice with how little observation or public interest, on the whole, the various applications of electricity are one by one brought into use, and how soon people come to take as a matter of course each novelty which does so much to modify the features of modern life. Now and again, indeed, may come a spasm of sensational interest in some group of new discoveries. A few years ago, when Mr. Edison wished us to understand that, Bacon-like, he had taken all electrical knowledge as his province, and his alone, the English, and, still more, the American journals were setting their readers agape at the wonders to be wrought for us by the magician of Menlo Park. One would have fancied that in a very few years all the old-fashioned machinery of society might as well be laid aside as so much obsolete lumber, and that the present decade of the nineteenth century was to be a new departure in the history of man. Such contrivances as pens and inkstands were to become antiquarian curiosities, except perhaps in Government offices, where the force of red tape could hardly fail to bind the old order of things together for a century or two; the telegraph wires were soon to serve for all kinds of correspondence, while, however, all clumsy apparatus like our Morse recorders and Wheatstone automatic instruments might forthwith be packed off to the Sandwich Islands, or some region not yet affected by the spread of education. With the help of the electric light we were to lengthen our days by stealing all the hours of the night, if so disposed. Armies were to sleep secure with microphones posted in every direction as sentinels who would never go to sleep; campaigns were to be directed by word of mouth from generals far out of sight; naval supremacy was to fall to the most complete electric torpedo service; railway trains were to work their own signals; burglars were to give their own alarums at every keyhole; fires were by their own mere motion to send for the engines within a few moments of breaking out; amateurs were to bottle their favourite music; authors were to dictate their immortal ideas to the public direct; the telegraphic Ariel was to take the place of the printer's devil; the eloquent debates of Lord Beaconsfield and Mr. Gladstone, instead of being wasted on a sleepy House of Parliament, might be given forth loud enough to be heard by all London. There were, indeed, as sick folks might think in such a case, inconveniences as well as advantages proposed in the new order of things. Walls were to have microphonic ears, and one's most secret conversations might be proclaimed upon a telephonic house top. Hamlet could perhaps not venture a soliloquy on the question of suicide without conveying prompt information to the nearest police station; Brutus and Cassius would do well to conspire by means of the deaf and dumb alphabet; Pyramus and Thisbe might indeed converse at their ease through not one, but a thousand walls; but Romeo and Juliet must go out of doors in all weathers if they wished to make sure that their fond extravagances were not being bellowed into the ear of every gossip in Capulet and Montague society.

All these sanguine predictions have not yet been realised, though some of them have, and others are nearer realisation than may be dreamed of in our newspaper philosophy. Naturally, there comes a reaction in public curiosity. The accounts of such truly remarkable inventions as the photophone and the telectroscope have fallen comparatively flat on unscientific ears. Our *savants* are as busy and as hopeful as ever, but they are no longer cheered by a chorus of leading articles, if that be any encouragement to them. When people hear of travelling or ploughing by electrical motive power, of restive horses to be curbed, of criminals to be executed, of whales to be taken—all by means of electricity—they are inclined to use a somewhat vulgarised quotation from Shakespeare, dismissing the whole story as a mere "great gooseberry" paragraph, and "very like a whale." Even in America, where this familiar spirit of modern science comes so much more nearly home to the business and the bosoms of the people, there are signs of a disposition to pooh pooh Mr. Edison, and to make up for blindly hailing him as the high priest of electrical knowledge by equally unjust detractation of the really great services which he has rendered to practical science. It is quite evident that the current of public excitement is induced, not in proportion to the true importance of any electrical epoch, but according to conditions outside the sphere of scientific calculation.

This is well illustrated in the case of the electric light. Within the last year far more has been done towards bringing it into general use than at the time of the panic in gas shares; yet editors are aware that their readers do not care to

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hear much about the Swan or the FitzGerald systems, which however, seem likely to make themselves heard of before long. Those interested in the gas monopoly, indeed, are more concerned, as may be seen by the constant references to the progress of the electric light at their meetings. No great sympathy need be felt for gas monopolists, considering how they have used their customers, or we might point out to them that their capital is in little danger, since other ways are being opened for them to serve the public with the machinery now in their hands. Gas shareholders would do well to turn their attention to these openings, and not waste time and trouble in attempting to withstand the light of the future. As soon as electricity is ready gas will have to clear the way. There was a time when it seemed a stupendous invention, and its introduction was duly scouted and opposed by the same wiseacres who hesitated so long before availing themselves of the new-fangled steamboats and railways. Public opinion is more wide awake now, though it nods at times, and the day is close at hand when we shall no longer consent to burn the air we breathe, or to defile it in order that we may see.

ON THE CONVERSION OF RADIANT ENERGY INTO SONOROUS VIBRATIONS.

BY WILLIAM HENRY PREECE.

Messrs. Graham Bell and Sumner Tainter* have shown that, under certain conditions, intense rays of light, if allowed to fall with periodic intermittence upon thin discs of almost every hard substance, will set up disturbances in those discs corresponding to this periodicity which result in sonorous vibrations. Mr. Bell† has subsequently shown that such effects are not confined to hard substances, but that they can be produced by matter in a liquid or gaseous form.

These discoveries have elicited a considerable amount of interest, and have led to the inquiry whether the sonorous effects are due, as the discoverers themselves surmised, to *light*, or as the President of the Royal Society, Professor Tyndall, and others have suggested to radiant *heat*.

Messrs. Bell and Tainter have partially answered this question by showing that the disturbances are not necessarily due to light, for they found that sheets of hard rubber or *ebonite*—a substance opaque to light—do not entirely cut off the sounds, but allow certain rays to pass through, which continue the effect. M. Mercadier, who has studied the subject with great care,‡ has shown that the effects are confined to the red and ultra-red rays. Moreover, Mr. Bell has shown that gases, such as sulphuric ether, which Professor Tyndall has proved to be highly absorbent of heat rays, while they are transparent to light rays, are remarkably sensitive to this intermittent action. Dr. Tyndall has more recently read a paper before the Society§ proving that these sonorous effects are a function of all gases and vapours absorbing radiant heat, and that the intensity of the sounds produced is a measure of this absorption.

The negative proof of Messrs. Bell and Tainter can be rendered positive if it can be shown that ebonite is *diathermanous*. The author provided himself with several sheets of different substances, and a sensitive radiometer. A standard candle and a lime light were used as sources of energy, fixed, the former four inches, and the latter four feet, from the riadiometer, which was carefully screened from all disturbing influences but that of the source. The number of revolutions made by the radiometer per minute was counted, and the average of several observations was taken. The following is the result, and the numbers indicate the relative diathermancy of the substances used to the source of light used:—

Experiments on Diathermancy.

Material.	Source of radiant energy. Candle, 4 in.	Lime light, 4 ft.
Air	100·	100·
Ebonite, No. 1 (·4 mm.)	60·	91·
,, ,, 2 (·9 mm.)	24·3	79·3
,, ,, 3 ,,	24·3	79·3
,, ,, 4 ,,	24·3	68·2
,, ,, 5 ,,	24·3	68·2
,, ,, 6 (·4 mm.)	0·	9·
India rubber (native)	44·3	61·4
,, (prepared)	60·	54·5
,, (vulcanised)	0·	0·
,, (and ozokerit)	0·	6·8
Ozokerit (·5 mm.)	0·14	9·
Carbon (2· mm.)	0·	—
Carbonised paper	0·	—
Blue foolscap	0·	4·5
White note paper	0·	4·5
Thin foreign	0·	—
Tissue	0·6	—

* American Association for the Advancement of Science. Boston, August 27, 1880.
† *Journal of the Society of Telegraph Engineers*, December 8, 1880.
‡ *Comptes Rendus*, December 6, 1880.
§ *Proceedings Royal Society*, January 3, 1881.

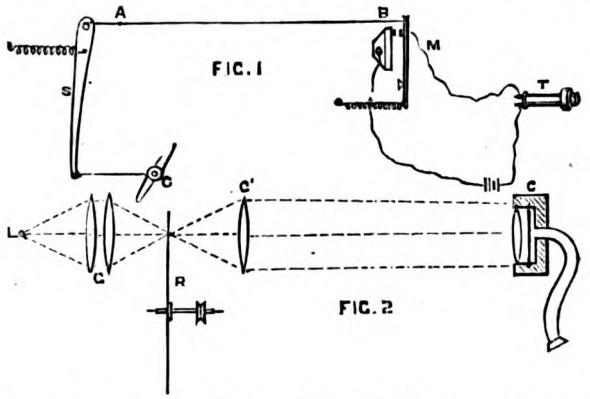
Ebonite was, however, proved to be very variable, and while some pieces proved to be as diathermanous as rock salt, others of the same thickness were found to be quite athermanous.

Ebonite, therefore, being sometimes diathermanous and opaque, it is clear that the sonorous vibrations of Bell and Tainter are the result of disturbances produced by some thermic action rather than by any luminous effect. Several other experiments made by them confirm this conclusion, notably those made upon crystals of sulphate of copper, which Mr. Crookes has shown to be highly opaque to rays of low refrangibility.*

Now, the questions arise, is this thermic action expansion and contraction of the mass due to its absorption of heat? Or is it a disturbance due to molecular pressure similar to that which produces the rotation of the radiometer? Or is it due to some other cause?

The argument against the first assumption when applied to hard discs is that *time* is a material element in such actions, and that the rate of cooling of warmed diaphragms is too slow to admit of such effects. Lord Rayleigh† has questioned the validity of this argument, and has shown that if the radiating power of the body experimented on were sufficiently high a slow rate of cooling would be favourable to rapid fluctuations of temperature. It became desirable to test this point experimentally. The following apparatus was constructed for the purpose.

A B is a thin strip or wire, six centims. in length, of the substance to be examined, fixed to a platinum "make and break," M, and adjusted to a lever, S, round whose axis is fastened a silk thread, the end of which is attached to the strip or wire at A, and whose position could be adjusted by a screw, C. Any variation of tension due to expansion or contraction of the wire would produce intermission in the electric currents passing through the telephone T, which, if periodically produced, would result in sonorous vibrations in the telephone. Heat from various sources and at various distances, from bright lime light to dull heat from hot metallic surfaces, was allowed to fall through rotating vanes intermittently on A B; but notwithstanding every precaution, and the many materials used, not more than six interruptions per second could be produced, although the system was beautifully sensitive to the smallest changes of temperature.



The best effect was obtained when A B was a thin ebonite wire about ·5 millim. in diameter, and 6 centims. in length.

It was evident from these experiments that the sonorous effects of hard discs could not be explained by the change of volume due to the impact of heat rays, and their absorption by the mass of the disc.‡

Is the action, then, due to molecular pressure similar to that which produces the rotation of the radiometer?

It is quite true that the radiometer effect is one visible only in very high exhaustions, but Mr. Crookes (*Phil. Trans.*, 1878, Part I., § 220) detected "the existence of molecular pressure when radiation falls on a black surface in air of normal density."

Whenever radiant energy falls on an absorbent surface in air, such as a disc of blackened wood, its wave-length is degraded or lowered, and it is converted into thermometric heat. The molecules of air striking this warmed surface acquire heat, and move away from it with increased velocity, and as action and reaction are always alike in moving away, they give the body a "kick." Since there is no such action on the other side of of the disc, there is a difference of pressure between the two sides, which gives it a tendency to move away from the source of energy. The effect is very much smaller in air at ordinary pressures than in air at a very low vacuum, because in the former case the mean free path of the molecules is very small, and the rebounding molecules help to keep back the more slowly approaching molecules. Nevertheless, molecular pressure is experienced, and if of sufficient magnitude and rapidity it ought to produce sonorous vibrations. It seemed probable that the element of time does not enter here so prominently as in the previous case, for the radiometer effect is a mere surface action of the disc, and not one affecting its mass. Hence it was hoped that the retarding effects would be eliminated. If the sonorous action, therefore, be due to a radiometer action, a difference of effect would be observed if the side of a disc *exposed* to the source of energy be either blackened by lampblack or camphor carbon, or if it be polished or whitened.

An apparatus was constructed similar in principle to that described by Messrs. Bell and Tainter. The source of light (L) was an oxyhydrogen lime-light. The rotating disc (R) was of zinc perforated with holes, which could be noiselessly rotated, so as to obtain 1,000 intermittences per second. Glass lenses (G) were employed to focus the light upon the perforations of the rotating disc, and another (G′) to render the rays parallel on the other side of the disc. A mahogany case or cup (C) to retain the discs to be experimented upon was constructed as shown in section in Fig. 3, and fixed 400 centims. from the source L; *a* being the disc, 5 centims. in diameter, clamped on by screws, a brass tube, *b*, to which the india rubber

* *Phil. Trans.*, Part I., 1878, p. 268.
† *Nature*, January 20, 1881.
‡ This conclusion was confirmed by subsequent experiments, notably by Experiments 7 and 41.

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hearing tube (*h*) was fixed; *c* a circular air space behind the disc 6 centims. in diameter, and 3 millims. to 5 millims. deep. Cavities of various dimensions and forms, spherical, conical, and trumpet-shaped, were tried, but the ones described were those which gave the best effects.

Experiment 1.—An ebonite disc well blackened on one side when exposed to the intermittent rays was found to produce sounds, which Professor Hughes estimated to be about 20 as compared with his sonometer scale.*

2.† A similar ebonite disc equally well whitened, gave slightly less intense sounds, estimated at 18.

3. A zinc disc blackened gave sounds = 8.

4. A similar disc polished gave only sounds = 2.

5. A mica disc blackened gave scarcely any sounds at all.

6. A clean mica disc gave sounds = 5.

These effects were produced many times, and on different occasions, and they were so unsatisfactory as to throw doubts on the accuracy of the radiometer explanation. They were not so decided as theory led one to anticipate. The effects produced by the zinc disc, though very weak, favoured the theory; those given by the mica disc complely refuted it; while those given by the ebonite discs were almost of a neutral character.

It was, however, thought that if D be the disc (Fig. 4), and C the source of light, then if the excursions of the discs to and fro were due to expansion from the absorption of heat, it would first bulge towards A, since the side towards the source of light would expand first. If, on the other hand, it were due to the radiometer effect, it would first bulge towards B.

7. An extremely delicate electrical contact arrangement was constructed to determine this by means of a telephone, which recorded the excursions to and fro of the disc; but the result was sometimes in one direction, and sometimes in the other. Moreover, the effect was slow, and we failed to obtain more than five distinct vibrations per second.

This result raised the question whether in Bell and Tainter's experiments *the discs vibrated at all*.

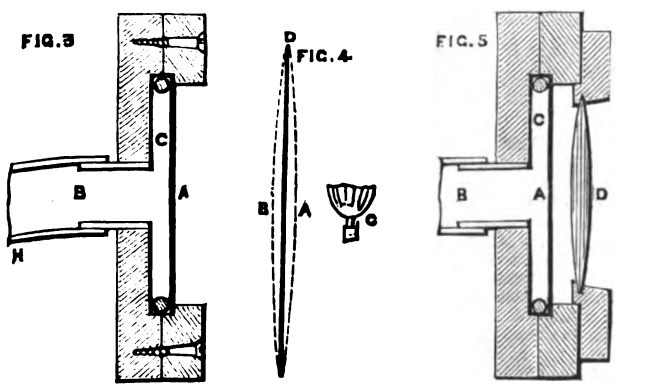
8. A delicate microphone was fixed in various ways on the case, Fig. 3. Although the sounds emitted in the hearing tube were as intense as indicated in experiment 1, scarcely any perceptible effect was detected on the microphone. Had the disc sensibly vibrated, its vibrations must have been taken up by the case. A microphone never fails to take up and magnify the minutest mechanical disturbances.

It was thus evident that the disc did not play a prime part in this phenomenon, but it appeared as Professor Hughes suggested, that the result might be due wholly to an expansion and contraction of the air contained in the air space *c*, Fig. 3.

An entirely new set of cases and discs were now constructed, but of the same dimensions.

10. With a new clean case and an ebonite disc, the sonorous effects were feeble, viz., 15 on the sonometer scale.

11. If, however, a lens (*d*) were placed close in front of the ebonite disc *a* (Fig. 5), the sonorous effects were magnified considerably, rising at once to about 40.



12. A case was constructed similar to that shown in Fig. 5, but with a tube at the side, as well as one at the back, communicating with the air cavity in front of the disc, as well as that behind, and whether one listened at one place or the other, the effect was equally good, indicating that the results were most probably due to the expansions of the contained air.

13. When the one tube was stopped and opened by a cork while the other tube was used for listening, the quality of the sounds varied more than the intensity, but there was distinct evidence of variation.

14. The ebonite disc of this case was now fitted with an extremely delicate microphone, which in this case gave good indications upon the telephone, but whether the vibrations were the results of the vibrations of the disc itself, or of the air in which the microphone was placed, was doubtful.

15. If the lens *d*, Fig. 5, were removed, and the disc left supported without any air cavity, either behind or in front of it, *no perceptible sound could be obtained*, proving that the effects were really due to the vibrations of the confined air, and *not to those of the disc*. It was, therefore, determined to dispense with the disc altogether.

16. Case No. 1 similar to Fig. 5 was taken, and the disc removed, but the lens remaining, the sonorous effects were *nil*.

17. Another case (No. 2), also similar to Fig. 5, was taken under similar circumstances, *i.e.*, *without the disc*, but the effects were very loud—60 in fact, the best results which had yet been obtained. Now, the only difference between the one case or cup and the other was that the one *was blacked in the interior*, and the other was not.

18. Hence Case No. 1 was again taken without the disc, and though when clean it gave no effect, when its interior was blacked by camphor smoke, it gave sounds as strong as those in Experiment 17, viz., 60. It was thus evident that the sonorous effects were materially assisted by coating the sides of the containing vessel with a highly absorbent substance, such as the carbon deposited by burning camphor. It remained to be seen how far the lens played a part in this phenomenon.

19. The lens was now removed from the front of the case, and it was replaced by a movable glass plate (1·5 millims. thick); the sounds were the same, but they gradually ceased on gradually uncovering the front opening of the case, so as to give the air room to expand.

20. The glass plate *e* was replaced by a heavy, rigid plate of rock salt 13 millims. thick, and the sounds were equally loud, namely, =60.

21. The plate *e* was replaced by white note paper. The sounds were very faint, but perceptible.

22. It was replaced by thin cardboard, and the effect was *nil*.

23. All these effects were produced equally well, whether the cases were placed at C, Fig, 2, 400 centims. from the source of light, or 16 centims. from the rotating disc R, but in the latter case their intensity was, of course, always increased.

Hence it is abundantly evident that these sonorous vibrations are due to the motions of the contained air, and not to those of the disc; that they are actually improved by the removal of the disc, that their production is materially assisted by lining the surface of the containing space with an absorbent substance, that they are dependent on the heat rays that pass through, and that they disappear when the rays are cut off from the air cavity by an athermanous diaphragm.

24. Dr. Tyndall having shown in the paper already referred to, that water vapour responded actively to these intermittent actions, a clean empty one-ounce glass flask was taken and exposed to the intermittent beams. No sound was produced.

25. It was then filled with water vapour by pouring a small quantity of water into it, and warming it in a flame, fair sounds of an intensity, 25, were the result.

26. The flask was filled with the dense smoke from burning camphor, and the sounds were intensified considerably.

27. The case was taken and a glass plate 1·5 millims. thick fixed in front of it as before.

a. When the glass was dry, sounds were 20.

b. When the glass was wetted on the inside, sounds were 25.

28. Another clear one-ounce glass flask was taken.

a. When clear, sounds = 0.

b. When filled with tobacco smoke, sounds = 5.

c. When filled with heavy camphor smoke, sounds = 30.

29. One side of the flask was blackened on the outside, the other side remaining clear.

a. On exposing the clear side to the light fair sounds, 25, were obtained.

b. On exposing the blackened side, *no sounds were produced*.

30. The flask was blackened *in the interior* on one side only.

a. When the blackened side was near the source, sounds = 25.

b. When it was away from the source, sounds = 30.

c. When the flask was cleaned, all sounds disappeared.

31. A thin glass plate was now blackened on one side and placed in front of the case.

a. When the black surface was outside, *no sounds were obtained*.

b. When the black surface was inside, good sounds, 30, were the result.

c. When the glass was cleaned, the sounds became = 50.

32. An ebonite plate was similarly treated.

a. When the blackened surface was outside, sounds = 15 were obtained.

b. When the blackened surface was inside, the sounds were = 3.

This being an anomalous result, several experiments were now made to test the behaviour of opaque and transparent bodies, when used as discs, for while in the previous experiments the effect was greatest when the blackened surface faced the interior, here we find the opposite result produced, viz., the greatest effect was produced when the blackened surface was on the exterior.

33. Another ebonite disc 0·6 millim. thick was made dull on both sides by rubbing it with emery paper. It was fixed in Case No. 2, Fig. 5, without the lens.

a. It gave sounds = 15.

b. It was now blacked on one side, and when that side was turned to the source, it gave sounds = 30.

c. The unblackened side was turned to the source, and it gave sounds = 15.

34. A thin glass plate (1·5 millims. thick)—

a. When clear, gave sounds = 50.

b. When blackened *thinly* on one side, and that side turned to the source, it gave sounds = 20.

c. When blackened thickly on one side and thinly on the other—

1. Thick side to light, sounds = 0.
2. Thin side to light, sounds = 20.

35. A glass plate (3 millims. thick) was blackened on one side.

a. Black outside, sounds = 2.

b. ,, inside, ,, = 30.

36. A clean mica plate (1·2 millims. thick)—

a. Gave sounds = 30.

b. When blacked on one side.

1. Black outside, sounds = 10.
2. ,, inside, ,, = 30.

37. Thin copper foil blacked on either side, sounds were *nil*.

38. A copper disc (0·2 millim. thick) blacked on one side.

a. Black outside, sounds = 3.

b. ,, inside, ,, = 0.

39. Zinc foil blacked on one side.

a. Black outside, sounds = 10.

b. ,, inside ,, = 3.

40. Zinc disc (0·7 millim. thick) blacked on one side.

a. Black outside, sounds = 10.

b. ,, inside ,, = 3.

* Professor Hughes's sonometer *Proc. Roy. Soc.*, No. 196, 1879, proves an excellent apparatus to estimate the relative intensity of low sounds, for by shifting the induction coil from one side to the other, we can pass from an absolute zero or pure silence to a limit of sound of considerable intensity. The scale divides this space passed over into 100 equal parts, any number of which give a fairly approximate value of the sounds compared. The ear has to determine the equality of the intensity of the two sounds, *i.e.*, of the sonometer and the source investigated, and the value of the latter is given in terms of the scale of the former.

† The consecutive figures indicate the number of experiments.

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It thus appears that transparent bodies behave in an opposite way to opaque bodies. Glass and mica can be rendered athermanous and silent by making the carbon deposit sufficiently thick. Zinc, copper, and ebonite can produce sonorous effects by a proper disposition of carbon. The effect in these latter cases may be due either to molecular pressure, in fact, to a radiometer effect, though very feeble in intensity; or it may be the result of conduction through the mass of the diaphragm, that is, radiant heat is reduced to thermometric heat by absorption by the carbon deposit on the *outside* of the disc, this heat is transmitted through the disc and radiated to the absorbent gases in the interior.

41. To test these questions, a delicate microphone was fixed on a zinc disc (0·7 millim. diameter) without any air-cavity in front of or behind it.

a. The disc was blackened; no measurable trace of sound was perceptible.

b. The disc was cleaned, with precisely the same result.

42. The zinc disc was now replaced on the case, Fig. 5, with the air-cavity, and sounds = 10 were emitted as before.

a. The zinc was neatly covered with white paper—a highly athermanous substance; the sounds were *nil*.

b. The paper was blackened; the sounds were still *nil*.

c. The zinc was covered with clear mica; faint but unmeasurable sounds were heard.

d. The mica was blackened; no perceptible sounds were obtained.

e. The zinc disc was blackened slightly in the usual way; sounds = 10 were obtained.

f. The zinc was *thickly* blackened; all sounds disappeared.

43. Ebonite discs of different thicknesses were used, and layers of carbon of different thicknesses were deposited on the thinnest of them. The sounds became fainter and fainter as the thickness of the layer of carbon and the thickness of the ebonite increased, until they disappeared altogether.

These experiments fully establish the inference that the effect is one of conduction, and that the blackened surface of an opaque body like zinc acts as though the source of heat were transferred to the outside surface of the disc.

44. Tubes of various sizes and dimensions were now tried, to confirm Messrs. Bell and Tainter's observations on tubes. They invariably gave out satisfactory sounds when the intermittent rays were directed into the interior of the tubes, which were always considerably intensified by blackening their interiors, and closing the open end with a glass plate.

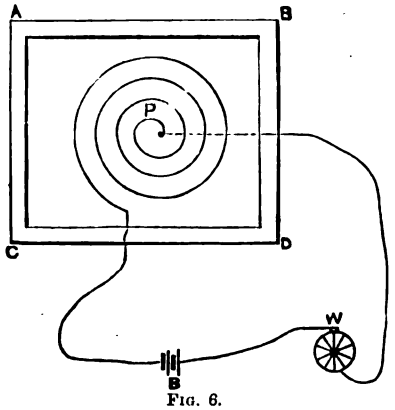

FIG. 6.

45. Since the sounds varied considerably in intensity, according to the number of intermittences per second transmitted, white and ruby glass plates were used, and it was found that the maximum effect (60) was produced when the note corresponding to the intermittences was—

With white glass ..... d'=297 vibr. per sec.
With ruby ,, ... b=247 ,, ,,

This showed that the element of time was a function of the amount of radiant heat transmitted through the plate.

46. The two cases, which possessed air-cavities of different dimensions, were tried with white glass:

Case 1 gave b 247.
Case 2 ,, d' 297.

Hence it is evident that there is a time element, and that the loudness of the note emitted depends upon the rapidity with which the contained air not only absorbs the degraded energy, but upon the rapidity with which it gives up its heat to the sides of the case and the exits open to it. Though the pitch of the maximum note varied with the cavity and the amount of radiant heat transmitted, its quality never varied, notwithstanding the great diversity of materials used as diaphragms.

47. Since these sonorous effects are due to the expansions of absorbent gases under the influence of heat, and since wires are heated by the transference of electric currents through them, it seemed possible that if we enclosed a spiral of fine platinum wire, P (Fig. 6), in a dark cavity, *abcd*, well blacked on the inside, and sent through it, by means of the wheel-break W, rapid intermittent currents of electricity from the battery B, heat would be radiated, the air would expand, and sounds would result. This was done, and the sounds produced were excellent; in fact, with four bichromate cells sounds more intense than any previously observed were obtained.

Furthermore, it was evident that if the wheel-break (W) were replaced by a good microphone transmitter articulate speech should be heard in the case *abcd*. This was done, and an excellent telephone receiver was the consequence, by means of which speech was perfectly reproduced.

The explanation of these remarkable phenomena is now abundantly clear.

It is purely an effect of radiant heat, and it is essentially one due to the changes of volume in vapours and gases produced by the degradation and absorption of this heat in a confined space. The discs in Bell and Tainter's experiments must be diathermanous, and the better their character in this respect the greater the effect; remove them, and the effect is greater still. Messrs. Bell and Tainter * showed that the sounds maintained their *timbre* and pitch notsithstanding variation in the substance of the disc, and M. Mercadier found that a split or cracked plate acted as well as when it was whole. These facts are consistent with the expansion of the contained air, but not with any mechanical disturbance of the discs. Moreover, M. Mercadier showed that the effect was improved by lampblack, but he applied it in the wrong place.

The discs may, and, perhaps, do under certain conditions, vibrate, but this vibration is feeble and quite a secondary action. The sides of the containing vessel must possess the power to reduce the incident rays to thermometric heat, and impart it to the vapour they confine, and the more their power in this respect, as when blackened by carbon, the greater the effect. The back of the disc may alone act in this respect. Cigars, chips of wood, smoke, or any absorbent surfaces placed inside a closed transparent vessel will, by first absorbing and then radiating heat rays to the confined gas, emit sonorous vibrations.

The heat is dissipated in the energy of sonorous vibrations. In all cases, time enters as an element, and the maximum effect depends on the diathermancy of the exposed side of the cavity, on its dimensions and surfaces, and on the absorbent character of the contained gas.

The remarkable property which deposited carbon possesses of reducing radiant energy to thermometric heat is strikingly shown by these experiments, and it suggests an important field for inquiry for those who are working in the region of radiant heat.

It is only necessary to add that, in carrying out these experiments, I have had the benefit of the presence and advice of Professor Hughes, and the inestimable advantage of the great mechanical skill, philosophical character, and experimental ability of Mr. Stroh, without whom, in fact, the inquiry could not have been accomplished.

LIGHT SIGNALS.

Luminous intermittent signals are likely to be useful as an optical telegraph for preventing collisions at sea, or enabling lighthouses to flash their names and other information, by means of the Morse code, as suggested by Sir William Thomson. The methods recently devised by M. Mercadier for producing them in a cheap way are therefore of importance.

In actual practice, when a light is used to make signals, the intermittences are produced by aid of a diaphragm moving continuously before the light. The light is thus rendered useless during the eclipses. In the ordinary optical telegraph, according to M. Mercadier, the loss of light is about 65 per cent.; and if the lighthouse adopts the plan of sending twice a minute a signal representing, in the Morse alphabet, the first or second letters of the name of the lighthouse (a sufficient number to indicate it very well), about 90 per cent. of the continuous light will go unutilised.

These considerable losses of light can be avoided by only utilising the luminous source when there is need for it, and extinguishing it, or nearly so, between whiles. In short, it is necessary to do with the light what is done with the electric current in telegraphing, where, between the signals, the current is stopped, and none is wasted.

To carry this out it is requisite that the luminous source employed can be rapidly produced at its maximum brightness, and as quickly extinguished, or, at any rate, diminished to a striking degree, by mechanical means. The solution of the problem can be ranged under two categories, namely:—Those in which the change is produced on the combustible producing the light, and those in which the change is produced by acting on the light. M. Mercadier takes the light produced from the burning of petroleum in oxygen by means of Dubosc q's lamp with round wick. At the centre, and in the vertical axis of this lamp, a tube rises, which has its upper part of very small diameter, debouching a little below the horizontal plane containing the extremity of the wick, which rises only a little above the cylinder containing it. The central tube abuts into a reservoir of oxygen, and sends a jet of oxygen into the middle of the flame, which is very white in colour, ovoid in shape, and of an intensity almost equalling the oxyhydrogen light.

Despite the elevated temperature of the combustion, the lamp heats itself little, consumes very little petroleum, and makes almost no soot, without requiring any trimming at all for several days at a time. This is due to the fact that the wick does not pass beyond the cylinder holding it, that the flame is produced by the combustion of the petroleum vapour at the centre of the jet, so that it is separated from the wick by a cushion of non-conducting gas. Moreover, when the flame is fed with air alone, and no oxygen, it is much dimmer, but on letting on the gas the flame suddenly brightens. It results from this, that the intensity of the flame can be readily varied in a simple manner for the production of luminous signals. By disengaging the oxygen suddenly in the centre of the flame, and suddenly suppressing it again, powerful flashes may be obtained.

* *Journal of Society of Telegraph Engineers*, December 8, 1880.

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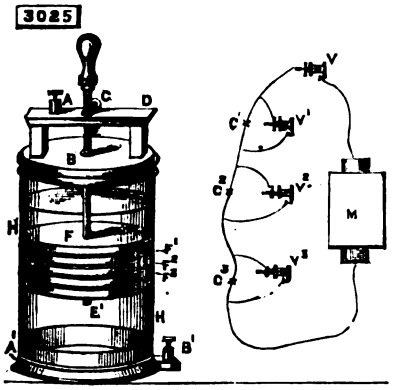
ABSTRACTS OF SPECIFICATIONS.

3025. IMPROVED METHOD OF ELECTRIC LIGHTING, INSURING THE INDEPENDENCE OF THE BURNERS. *P. Jensen.—Dated 21st January*, 1881.—(*A communication from M. Avenarius.*) 6*d*.

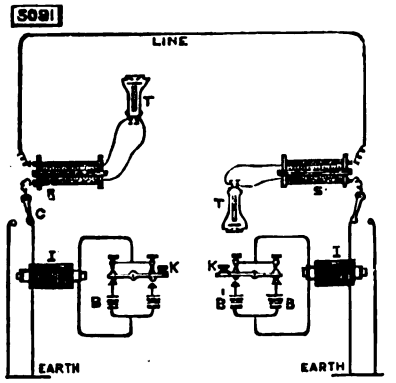
To obtain independent action the inventor uses shunt circuits, each containing an electrolytic apparatus. In Fig. 1 C (1, 2, and 3) are electrical burners in the same circuit, and fed by an alternate current dynamo-electric machine. Each of the conducting wires of the burners is connected to the corresponding electrode of the voltameter V (1, 2, and 3), which must be such as to permit of variation in the polarisation of the two electrodes of the apparatus as well as its resistance, according to the polarisation of the carbons of the corresponding burners, and to the intensity of light required. Fig. 2 is an electrolytic apparatus consisting of a cylindrical glass vessel, H, with metal bottom A and wooden lid B, the latter carrying a metal plate, D, on wooden supports, and with binding screw, *d*. D and B have two holes



through which passes metal rod E, carrying at its end—inside H—a metal disc, F, which has a glass stick, E¹, on which are fixed metal discs F (1, 2, and 3). These latter must fit the inside of H well, to prevent transmission of the current by the liquid between the sides of H and the discs. The thickness of the discs should be increased according to their distance apart, and it is well to coat them with platinum. The position of E, on which a scale is marked, and the distance of the lowest disc are fixed by a screw, G. The bottom, A¹, is provided with a second binding screw, B¹, and the vessel is filled with slightly acidulated water. Polarisation is determined by the number of discs, and resistance of the apparatus by their distance apart, particularly by the distance of the lowest disc from the vessel's bottom.

5091. IMPROVEMENTS IN ELECTRIC TELEGRAPHY, *H. J. Haddan.—Dated 7th December*, 1880.—(*A communication, S. L. M. Barlow.*) 6*d*.

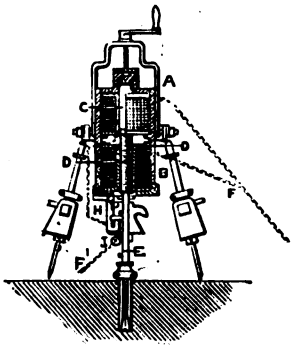
The inventor, Mr Barlow, of New York, uses secondary currents to obtain signals. As will be seen from the figure, he uses the coil preferably in connection with a sounder. His transmitting



key oscillates between four stops, two stops being connected to the like poles of two batteries, the other poles being connected to the primary coil and the other contacts.

5152. IMPROVEMENTS IN ELECTRIC DRILLS, *S. Pitt.—Dated 9th December*, 1880.—(*A communication from C. E. Ball.*) 6*d*.

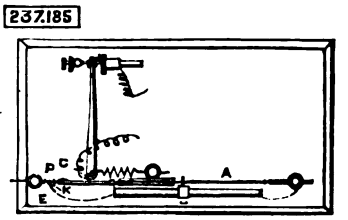
The drawing shows a longitudinal section of this drill. A cylinder, B, slides freely endwise on the frame, its movement being controlled by an adjusting screw. D¹ is a soft iron arc actuated by the coils C and D. At the upper end of the



cylinder is a small air chamber, the air being compressed at each stroke. The current is passed through each coil alternately, one coil drawing drill back, the other pulling it forward to make its stroke.

237,185. TELEGRAPH RELAY, *Geo. M. Hopkins, Brooklyn, N.Y.—Filed July 10th*, 1880.

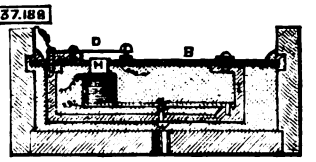
Claim.—(1) In a telegraph relay, the combination of the expansion wire A, friction piece G, spring, and arbour, as shown and described. (2) The method of augmenting the expansion of an electrical conducting wire by the application of external heat, as herein specified. (3) In a telegraph relay, the combination of a heater with an expansion wire, as specified. (4) In a telegraph relay, a rotative contact surface, in combination with a vibratory contact surface, substantially as



specified. (5) In a telegraph relay, a movable electrical conductor, in combination with the expansion wire, for putting more or less of the expansion wire into circuit, as specified. (6) In a telegraph relay, the contact pins P, electrically connected with the main line, and the movable contact bar K, connected with the main line, in combination with the expansion wire A and spring E, as herein specified.

237,188. TELEPHONE, *John H. Irwin, Morton, Pa.—Filed April 24th*, 1880.

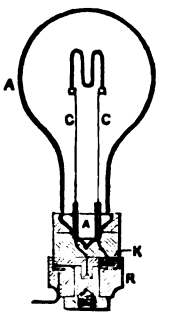
Claim.—(1) A battery provided with two independent electrodes insulated from each other, but excited by the same solution, for the purpose of taking out of the same battery two independent currents, whereby a regulator in the battery independent of the transmitter current may be operated to compensate the effect of fluctuations of electromotive force, substantially as set forth. (2). In a telephone, variable resisting electrodes combined with an electro-magnet, applied and adjusted to regulate independent of the transmitter current the electro resistance with a varia-



bility corresponding to the fluctuations of electromotive force in the battery. (3) In combination, the movable electrode D, and regulating electro-magnet H, and the battery having independent + electrodes, as set forth. (4) The combination of the movable electrode D, and the regulating electro-magnet H, suspended in a bracket, I, attached to the under side of the diaphragm B. (5) The movable electrode D, combined with the regulating electro-magnet H, both mounted in attachments secured to the diaphragm B, substantially as set forth.

237,198. ELECTRIC LAMP, *Hiram S. Maxim, Brooklyn, assignor, by mesne assignment, to the United States Electric Lighting Company, New York, N.Y.—Filed March 9th*, 1880.

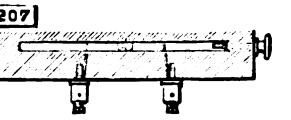
Claim.—(1) The combination of the globe A with the platinum connections C C¹, and the capillary spaces A filled with gum or wax, substantially as described. (2) The combination, with the globe of an incandescent electric lamp, of glass tubes extending up into said globe and surrounding the supporting conductors of the incandescent part of the lamp, the spaces in the said tubes being packed with a solid sealing substance. (3) The combination of the base, carrying the plug K,



with sub-base and the ring R, substantially as described. (4) In an electric lamp, the combination of a continuous incandescent conductor mounted upon electrical connections of platinum with a globe of glass enclosing such conductor and sealed directly to said electrical connections, and wax or gum applied to said globe where the electrical connections pass through it, substantially as described.

237,207. ELECTRIC TELEPHONE, *Allen W. Rose, New York, N.Y., assignor to Charles A. Cheever, same place; said Cheever assignor to himself as trustee.—Filed October 26th*, 1880.

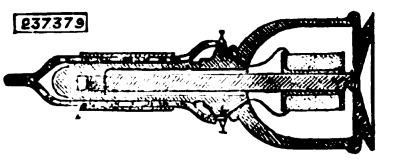
Claim.—(1) The combination, substantially as herein set forth, of the enveloping case, a magnet or magnets enclosed therein, and filings susceptible of magnetic or inductive action, in a loose condition, interposed in the magnetic field, to vary the electric current traversing the circuit in which they are included by changes in their condition by molecular vibrations transmitted



through the casing. (2) The combination, substantially as herein set forth, of the enveloping casing, magnets enclosed therein, placed end to end, with a space between them, metallic filings susceptible of magnetic or inductive action, in a loose condition, interposed in the magnetic field between the magnets, and a galvanic circuit in which the magnets and filings are included.

237,379. TELEPHONE, *Gay W. Forster, Chicago, Ill., assignor to the Foster Magnet Telephone Company, same place.—Filed September 10th*, 1880.

Claim.—(1) In a telephone, the combination of a permanent magnet, screw threaded at one end and notched at the other end, with a telephone handle or case provided with an axial recess, or hole, reduced and screw threaded at its rear end for the reception of said magnet, substantially as shown and described. (2) A telephone handle or case provided with an axial recess for the recep-



tion of a magnet, and with two holes parallel to said recess arranged to receive and protect the conducting wires, and with two holes formed at an angle to the magnet, and in the same plane with the parallel holes, for the purpose of connecting the terminals of the helix with the conducting wires.

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CORRESPONDENCE.

THE RETURN WIRE IN TELEPHONE CIRCUITS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I observe a controversy has risen in the United States between Mr. Brooks and Professor Alexander Graham Bell, with regard to the discovery of the use of a return wire to prevent the noises of induction on telephone circuits.

I think it right to mention that the second telephone circuit fitted in England was erected between my offices, 12, Queen-street, Cheapside, and the offices of Mr. Matthew Gray, the manager of the Silvertown Company, on this principle, by Mr. W. H. Preece, the electrician to the Post Office, before any patent was taken out by any one. The very first telephone circuit fitted in England was erected by Mr. Preece between my house and that of Professor Bell in Jermyn-street.—Yours, &c.,

W. H. REYNOLDS.

11, Moorgate-street, March 10, 1881.

PHYSICAL SOCIETY.

MARCH 12.—Sir W. THOMSON in the chair. New members: Mr. Colville Brown, Dr. J. P. Joule.

Colonel FESTIN read a paper by Captain Abney and himself on "The Absorption Spectra of Organic Bodies." The method of photographing the infra-red region of the spectrum gave better results for absorption than the thermopile. Organic compounds were chosen as giving the larger molecules. The apparatus employed consisted of a small Gramme machine, driven by a Brotherhood engine and an electric lamp, with a device for shifting the negative pole so as to get the crater on one side of the other carbon point. The image of the positive pole was allowed to fall on the slit of the spectroscope, the light of the arc not being used. Three prisms were used, and a camera with a back-swing to it, so as to get a considerable length of spectrum in focus. Maps of the various spectra were made, with six inches of the substance examined enclosed in a glass tube. Alcohols, acids, oils, and water were examined, and gave spectra of bands and lines. When hydrogen was absent in the compound, there were no lines, and the authors conclude the line to be due to hydrogen. Oxygen appeared to obliterate the space between two lines and make them a band. The authors hope by this method to detect the radicals present in a substance. They found correspondencies between some lines and lines in the solar map.

Dr. COFFIN said that two kinds of chloroform, apparently the same, produced different physiological results; the method might distinguish between these.

Sir WILLIAM THOMSON thought it might throw light on the ultimate constitution of matter.

Mr. BROWN read a paper on the "Definition of Work" in text books, and gave reasons for preferring that in Rankine's books.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES MARCH 16.		BUSINESS DONE WEEK ENDING MARCH 16. Highest.	Lowest.
Anglo-American	56¼,	¼	58¼	56¼
Do. Preferred	84½,	½	86½	84½
Do. Deferred	28⅛,	⅛	30⅛	28⅛
Brazil Submarine	10,	¼	10¼	10
Cuba	8½,	9½	9	9
Do. Preference	16½,	½	—	—
Direct Spanish	3½,	4	3½	3½
Do. Preference	13½,	½	13½	13½
Direct United States Cable	10⅛,	⅛	11	10⅛
Eastern Telegraph	9⅛,	⅛	9⅛	9⅛
Do. 6 per Cent. Preference	12½,	½	—	—
Do. 5 per Cent. Debentures, 1899	102,	104	104	102½
Eastern Extension	10,	¼	10¼	10
German Union	10⅜,	⅛	10⅜	10⅛
Globe Telegraph and Trust Company	6,	¼	6¼	6 3-16
Do. Preference	12 1-16,	3-16	12¼	12
Great Northern	11¼,	⅛	11⅛	11¼
Indo-European	26,	27	26¼	26¼
Mediterranean Extension	2⅛,	3	2⅛	2⅛
Do. Preference	10,	¼	10¼	10¼
Reuter's	10⅛,	11¼	—	—
Submarine	270,	290	—	—
West India and Panama	1⅜,	⅛	1 9-16	1⅜
Do. 1st Preference	6⅜,	⅛	6⅜	6⅜
Western Brazilian	8,	¼	8 1-16	7⅛
West. Union 7 per Cent. 1st Mortgage	122,	127	—	—
Do. 6 per Cent, Sterling Bonds	101,	104	—	—

TRAFFIC RECEIPTS FOR FEBRUARY, 1881.

COMPANIES.	Feb., 1881.	Feb., 1880.	Increase.	Decrease
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,900 estd.	3,140	—	240
Direct Spanish Telegraph Company	1,876	—	—	—
Direct United States Telegraph Company	16,390	—	—	—
Eastern Telegraph Company	46,463	44,591	1,872	—
Eastern Extension Telegraph Company	28,021	25,190	2,831	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

ADDRESSES.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5 BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha. India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

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BIRKBECK BANK.—Southampton Buildings, Chancery Lane.
Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
Letters of Credit and Circular Notes issued.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
Southampton-buildings, Chancery-lane

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby

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HARBURG-ON-ELBE.

London Office: 11/14, Tower Chambers, London Wall and Moorgate, E.C.

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GUTTA PERCHA INSULATED TELEGRAPH WIRE.

Also Covered with Silk or Cotton, Taped or Braided.

ELLIOTT BROTHERS,

449, STRAND,

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SCIENTIFIC INSTRUMENTS.

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Engine Room Reply Telegraphs.
Patent Ventilators.
Sea Water Distillers.

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NEWALL'S PATENT LIGHTNING CONDUCTORS.

Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'S PATENT COPPER-ROPE LIGHTNING CONDUCTOR,

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offered to the public. It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.

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Manufacturers of Iron and Steel Ropes for Colliery and Railway purposes. Rigging Ropes, Guide Ropes, &c.

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R. S. NEWALL & CO., LONDON, 130, STRAND, W.C.

LIVERPOOL—36, Waterloo Road. GLASGOW—68, Anderston Quay. Manufactory—GATESHEAD-ON-TYNE.

IMPORTANT TO TELEGRAPH COMPANIES.

THE SANITAS COMPANY (Limited), of Bethnal Green, E., have received the following gratifying letters upon the subject of Sanitas and its uses at Foreign Telegraph Stations:—

"THE MANAGING DIRECTOR, THE SANITAS COMPANY (LIMITED). "February 4th, 1880.

"We have now for more than a year been using your SANITAS soap and disinfectants in our ships, as well as at our stations, and find it greatly appreciated, more especially at tropical places, where the importance of sanitary arrangements is not well understood."

"London, 15th November, 1880.

"I think it right to inform you that our Superintendent at Mozambique says:—'I use the much-prized "SANITAS" freely, and feel perfectly safe wherever I sprinkle it.' "JAMES ANDERSON, Managing Director Eastern Telegraph Company (Limited), 66, Old Broad-street, E.C."

"SANITAS" DISINFECTING FLUID, No. 1, in 1/- and 2/6 bottles.
"SANITAS" DISINFECTING FLUID, No. 2, in 1/- pints.
"SANITAS" DISINFECTING OIL, @ 30/- per gallon.
"SANITAS" TOILET FLUID, in 1/- and 2/6 bottles.
"SANITAS" DISINFECTING POWDER, in 1/- boxes, and 17/6 per cwt.
"SANITAS" TOILET and NURSERY POWDER, in 1/- boxes.
"SANITAS" TOOTH POWDER, in 1/- boxes.

"SANITAS" DISINFECTING HARD SOAP, No. 1, in 6d. bars.
"SANITAS" DISINFECTING HARD SOAP, No. 2, in 4d. bars.
"SANITAS" SOFT SOAP, in 1/-, 1/9, 3/-, 5/-, 9/-, 12/6, and 24/- sizes.
"SANITAS" TOILET SOAP, in 1/6 boxes of three tablets.
"SANITAS" DISINFECTING FURNITURE CREAM, in 1/- bottles.
"SANITAS" DISINFECTING OINTMENT, in 1/- and 3/6 sizes.
"SANITAS" VETERINARY OINTMENT, in 2/6 tins.

SANITAS is Non-Poisonous and Without Stain, and is used by 400 Public Bodies.

NOTICE OF REMOVAL.

EDWARD PATERSON,

TELEGRAPH AND ELECTRICAL ENGINEER,

3, BEDFORD COURT, COVENT GARDEN, W.C.,

Will on and after the 1st May, 1880, REMOVE to

76, LITTLE BRITAIN, ALDERSGATE STREET, E.C

The Gower-Bell Loud Speaking Telephone.

TELEPHONE LINES ERECTED and MAINTAINED.

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THE FITZ-GERALD ELECTRIC LIGHT and POWER COMPANY (Limited).—Capital, £100,000, in Shares of £1 each. First issue of 5,000 Shares. For full Particulars, Prospectuses, and Applications for Shares, apply, in person, or by letter, to the SECRETARY, 13, York-buildings, Adelphi, W.C.

THE "JAMIN" PATENT ELECTRIC LIGHT

COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.

Capital 8,000,000 francs.

Proprietors of the Gramme Patent Machine for alternate currents.

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SLIP

THE CHINESE AMBASSADOR.—We hear that the Chinese Ambassador and suite paid a visit to the Silvertown cable works this week.

ELECTRIC LIGHT FOR WINDSOR CASTLE.—It is reported that the interior of the castle is shortly to be illuminated by the electric light.

TELEGRAPH EXTENSION IN ITALY.—The Minister of Public Works has authorised an increase in the telegraphic lines of the Alta Italia Railway, at an estimated cost of 135,163 lire.

M. ADER AND THE PARIS ACADEMY OF SCIENCES.—This gentleman has just been awarded 3,000 francs by the Academy for his advances in Phonetic Telegraphy, as also Telephony.

THUNDERSTORM.—On Monday afternoon heavy thunderstorms passed over South Staffordshire and Derbyshire, accompanied by snow and hail. The lightning was described as being very vivid.

MISDEMEANOUR BY TELEGRAPH.—A warrant has been issued against the chaplain of a provincial training college for governesses for having despatched telegrams in the name of the local chief constable with the object of intimidating, and for having intercepted the replies.

NEW COMPANY.—*La Lumière Electrique* says that a new company is to be established at Brussels, under the title of La Force et L'Electricité, which will make and sell every kind of electrical machine known. The capital will be 2,400 preference and 48,000 ordinary shares of 100 francs each.

STILL THEY COME.—*L'Electricité* announces yet another paper, rather hybrid as regards its title, which is *Le Gaz et l'Electricité*. This is going into the enemy's camp with a vengeance. Our contemporary also says that it is probable the exhibition will see another electrical journal launched.

THE TELEPHONE AND THE HOUSE OF COMMONS.—Efforts are being made to establish telephonic communication between the Houses of Parliament and the clubs and private houses of members. The cost, if carried out, will be £15 per annum for half a mile, £19 for a mile, and £4 for each additional half mile.

PRICES.—The prices as quoted are :—For gutta percha, per lb., 4d. to 3s. 3d., reboiled 3d. to 1s. 3d. For india rubber, per lb. : Para, fine, 3s. 7d., negrohead 2s. 5d., Central American 1s. 10d. to 2s. 4d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d.

NEW CABLE.—It is proposed to lay a cable between the island of Sakhaline and the mainland of Western Siberia, a distance of about 63¼ nautical miles. This island is a large Russian penitentiary, and, with the exception of four months in the summer, is cut off from the mainland, the only means of communication being by sledges.

ANOTHER PETITION FROM THE ORKNEYS.—We hear that the inhabitants of the island of Sanday, Orkney, have resolved to petition the Postmaster-General to establish a telegraph station in the island. The Shetland cable lands at Sanday and passes through the island, and the company who had the telegraph before the Post Office took it over had a station there.

PARIS BEHIND THE TIMES.—The authorities of this city have just discovered that, although the fire stations have telegraphic communication, there is none with the water companies, and there is no system of fire alarms at all as in London and elsewhere. The disastrous fire which took place the other day will, no doubt, wake up our neighbours to a sense of their insecurity.

PATIENCE OFF HER MONUMENT.—The Edinburgh correspondent of the *Gas Journal* wonders whether the Philosophical Society of Glasgow have become so enamoured of the electric light as to lose sight of the public duty which they have to perform, namely, of publishing the awards of the committees on the various articles shown at the exhibition of gas apparatus in October last.

ELECTRIC LIGHT AT ROUEN.—This city is to be illuminated, and tenders have been received from Messrs. Siemens and a local firm. The project will include the establishment of a motor of 500 horse-power, capable of supplying 1,200 lamps, of 50 Carcel burner power each. The light will be distributed amongst subscribers, who will be enabled to turn their own lights off and on at will.

TENDERS FOR TELEGRAPH STORES.—The Secretariat de la Commission de Reception des Postes et Télégraphes at Malines, Belgium, invites tenders for supplying 250 tons of galvanised iron wire, 1½ ton galvanised steel wire, and a large quantity of sundry fittings, insulated copper wire, insulators, &c. Particulars of the Secretariat as above, where tenders will be received up to the 30th inst.

UNDERGROUND WIRES.—The underground wires being laid between Paris and Nancy are placed in an iron tube, accessible by means of doors at every 500 metres distance. In this way the necessity for breaking up the ground to get at the wires is obviated. The working of this system will be of interest to telegraph engineers on this side the channel, particularly now that the question of Overhead v. Underground wires is so prominent.

ELECTRIC LIGHT IN THE CITY.—At the last meeting of the City Commission of Sewers a petition was presented from the ratepayers and inhabitants of Leadenhall, Fenchurch, and Billiter-streets, asking to have the electric light tried in those thoroughfares. The inhabitants of Newgate and Aldersgate-streets were said to be also anxious for a trial of the light there. At Ipswich a committee has been appointed to consider the desirability of using the light for public purposes.

FESTIVITY.—The annual dinner of the senior *employés* of the Glasgow Postal Telegraph service was held on Saturday last. Mr. G. H. Midgley occupied the chair. The toasts "The Queen and Royal Family," "The Postmaster-General and Telegraph Service," "The Engineering Department," and "The Ladies," were proposed and replied to. Several of those present added much to the enjoyment of a very pleasant evening by their able rendering of songs and recitations.

THE SOCIETY OF ARTS.—On Thursday evening Professor J. Perry read a paper before the Applied Chemistry and Physics Section, on the "Future Development of Electrical Appliances." By the courtesy of Mr. Wood, the secretary of the society, we were able to see an advance proof of the lecture, and we found that any short abstract would fail to convey a just impression of the author's statements. We therefore hold the paper over in order to be able to give it as a whole.

RADIANT ENERGY.—A correspondent points out that Mr. Preece's discovery not only accounts for what had hitherto been considered photophonic phenomena but it also explains the well-known sounds in "wire telephones"—that is, telephone receivers constructed of wire alone without diaphragms; as also probably the so-called magnetic sounds. Experimenters have no doubt used ear-pieces to collect the sounds,

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and have not suspected that the air so enclosed was the chief element in producing them.

Experiments with a Volta-condenser.—Sir W. Thomson has made experiments which show that by moistening the opposing surface of a volta-condenser, and substituting a water-arc for a metallic one in the determining contact, there is no measurable difference of potential when contact is made by means of a drop of clean water between opposed polished surfaces of zinc and copper; and that the action of dry polished zinc and wet oxidised zinc when opposed to dry copper and brought into contact by a metallic arc are similar.

Use of the Telegraph in France.—According to figures published for the year 1878, it would appear that in the department of Seine (including Paris) there were 100 telegrams despatched for every 100 inhabitants, or one per inhabitant, whilst in Bouches du Rhone the ratio is 60 messages per 100 inhabitants; after which we have Alpes Maritimes and Hérault, 57 per cent.; Seine Inferieure 52; Meurthe et Moselle, 46; Gironde 44; Rhone, Loire Inferieure and Allier 40 per cent.; and so on in a descending scale till we come to the departments of Dordogne and Lot, where but one telegram is sent per year for every 22 inhabitants.

Earth Currents.—From several quarters objections reach us as to Professor Ayrton's explanations of earth currents in the neighbourhood of running streams. It is urged that if the deflections followed the progress of the water, they ought to drop at low tide and high tide to zero; and at the turn of the tide the deflections ought to go full over the other way; whereas they are said to be gradual. Again, it is disputed that a steadily flowing body of water would have the effect alleged; whilst another correspondent asks whether the effect is supposed to be due to the flow of the water, or to its constantly diminishing or increasing in depth.

The Telephone Company.—In the Court of Chancery a petition has been applied for by the Right Hon. E. P. Bouverie, the owner of 100 shares in the above company, which is in course of voluntary liquidation for the purpose of being amalgamated with the Edison Telephone Company, asking for the removal of the liquidator of the above company, who was also a director, in order that certain transactions by the directors of the company, which were alleged to be *ultra vires*, might be investigated by an independent person. The Master of the Rolls directed that the petition should stand over generally to allow of a meeting of the shareholders of the company to be called by the liquidator.

Telegraph Clerks' Grievances.—Numerous meetings all over the country have been held since the interview with the Postmaster-General, at which the speakers have complained of unfair treatment in that they were confronted with their superiors, before whom they did not dare to speak out. In the event of the answer of the Postmaster-General being unfavourable it has been resolved to hold a conference to decide on the course to be adopted. There can be no doubt as to the unanimity of the clerks, and we sincerely hope that anything approaching to a strike may be averted, and that the matter may yet be settled by a common sense talk between all parties. Mr. Fawcett deprecates haste, and again declares the subject is receiving his fullest consideration.

Reproduction of Solar Noises.—A correspondent of the *Scientific American*, speaking of Professor Bell's photophone and the reproduction thereby of the noises which accompany solar disturbances, says:—"In the case of the sun we have no assurance that the requisite conditions exist to enable us either to reproduce the solar noises on a small scale, or to originally produce anything similar to them. We certainly cannot say that the variations in its light come from the rays having been modified by sound waves in the solar atmosphere, nor is there any reason to believe that they are at all naturally proportional to any accompanying sound; and until one or the other of these conditions is shown to be a fact it seems to me that the results of Professor Bell's experiments will continue to be, as hitherto, 'not wholly satisfactory.'"

International Electrical Exhibition.—We would remind our readers that the last date for entries is the 31st instant. Our contemporary, *L'Electricité*, takes the opportunity in its last issue to make some well-deserved strictures on the English Government's refusal to take part in the Exhibition. *L'Electricité* cannot understand this action on the part of a country which claims Faraday, Davy, Wheatstone, and a host of others as its children. The ways of Government are not understanded of ordinary mortals—nor of themselves, we think. We hear that Italy has nominated a commissioner to the Exhibition. The Minister of Agriculture and Commerce, with an energy which our Government would do well to copy, has sent a circular to the Italian Chambers of Commerce asking them to lend their aid to the preparations for the Exhibition.

Barnsley Town Council and the Gas Company.—We really feel quite grieved for the gas companies. Not only have they the pleasure, or otherwise, of watching the strides that the electric light is making, but they are now being worried out of their lives by an impatient public, who refuse to pay just what may be asked of them for their gas. It really is too bad. We noticed the other day that Penistone were attacking their gas company on the subject of a reduction in prices, and now Barnsley is doing the same. The town council have gone so far as to ask what the company will sell their works for, and other home questions, some of which the company declined to answer. The town council will probably join in a petition with a gas consumer to the next Quarter Sessions to appoint some competent person to ascertain the the actual condition of the concerns of the company.

Automatic Recording of Telephone Messages.—In a book on the application of the telephone and microphone to physiological and clinical uses, Dr. Boudet describes his method of automatic recording of telephone messages. To do this he removes the diaphragm of the Bell telephone, screws to the wood one end of a steel spring, the other end being opposite the pole of the magnet. To the free end he solders a small piece of soft iron, weighing 1-10th of a gramme. Attached to this piece, and in the prolongation of the axis of the spring, he fixes a light bamboo arm 10 centimetres long, and terminated by a needle of whalebone. In fact, the diaphragm is replaced by a movable armature resembling the interruptor of an induction coil. The tracings are made on smoked paper, and transferred to glass. There are some points of difference as well as resemblance which make it probable that tracings of this kind may be deciphered, but the matter is in embryo yet.

Edison Electric Light Company.—The *Engineering News* of New York says that Edison has removed from Menlo Park to the City, and is now living at No. 65, Fifth-avenue, which has been leased for a long term by the company, the technical department of the business being carried on there. Vice-president Eaton is reported to have said that Edison's invention was complete, and they were at work getting rights in various cities to put the wires in the streets

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and to light the street lamps. They had received three or four thousand applications to light houses and hotels, but the company would only contract to light cities. A *Daily News* telegram of Wednesday says that the aldermen of this city (New York) have voted to give the Edison Electric Lighting Company the same privileges as the gas companies have for laying tubes and erecting lamp-posts in the streets and parks of New York. The Edison Company proposes to take the lower part of the city first and furnish lights for stores and houses, not lighting the streets at present. The wires are to be laid in tubes underground.

Swan's Lamps.—The good folks of Glasgow have been all agog the last few days, the motive power being the Swan lamp. As usual, there are many opinions freely expressed with regard to its efficiency and probable utility. One person thinks it perfection, and hopes that the citizens of Glasgow may soon be freed from suffocation and poisoning by gas; whilst another writes a long letter to the local press in which he proves to his own satisfaction, that it is impossible it can ever become an article of domestic use, on account of its cost, and the amount of attention it requires. Yet another protests that the ill effects of gas are preventable by the consumers looking after their burners, and the way in which the gas is consumed. In his opinion the data given by Mr. Swan are not sufficient to convince people that the electric light may be expected to forthwith snuff out gas. We do not know, but we suspect this gentleman of having gas shares. However, everyone agreed in the unanimity of their praise of the exhibition put before them; and what we mentioned in our Note of last week as likely to occur did happen, viz., the hall of the Philsophical Society was found too small for the accommodation of those anxious to hear Mr. Swan on Wednesday, and accordingly he consented to lecture the next night as well.

Atlantic Telegraphs.—The *Daily News* money article of the 21st instant contains the following:—"After a long-continued and heavy fall, accentuated during the past week, Anglo-American Telegraph stock recovered a little to-day. No less than five new competing cables are threatened from various quarters, and we are probably safe in saying that if the Anglo-American Company condescended to charge a low tariff—say 6d. per word—without fluctuations, little would be heard of continual new rivals establishing themselves for the purpose of being bought off and absorbed. It is as certain as anything in the future can be, that, in course of time, lower charges will rule, and the sooner the monopolist company reconciles itself to the necessity the better. Including the cables of associated companies, the Anglo-American has five in working order, which are more than enough for the business it obtains at 2s. per word, but would hardly be equal for long to what might accrue at 6d. When the new cables are laid and duly amalgamated or otherwise controlled, there should be no difficulty in bidding for increased business at permanently low rates. The business world would be greatly benefited, and the shareholders would be spared the harassing fears which from time to time attend rumours of new rivals and intermittent warfare."

Cantor Lecture.—The third lecture of the series on "The Scientific Principles involved in Electric Lighting" was delivered by Professor Adams, F.R.S., in the lecture theatre of the Society of Arts on Monday. The subject matter of this lecture was the use of magneto and dynamo-electric machines for electric lighting, and electric lighting by means of the arc. The lecturer commenced by stating that the laws of electric machines were those promulgated by Oersted, Ampère, Arago, and Faraday. He referred these machines to two classes, those giving alternate and those giving continuous currents, noticing that all machines really give alternate currents, but that by means of a commutator the current is made continuous in the external circuit. The early machines of Pixii, Clarke, &c., were mentioned, and Wheatstone's early work referred to. In 1854 Siemens introduced his armature, and the same year a patent was taken out, in which the invention consisted in sending the current from the armature through the coils of the magnet. This inventor was before his time, and the discovery passed unnoticed till, in 1867, Siemens and Wheatstone, independently, yet on the same evening, presented papers to the Royal Society on this subject. The original machine of Siemens was shown. The next great improvement was the introduction of the Gramme armature. The mathematical formula symbolising the efficiency of these machines was next given, and some of the older forms of machine mentioned. The measurement of the current was an important problem, and the lecturer described the electrometer method, giving the formula used. He also explained a new instrument constructed by Messrs. Elliott, on the system designed by Mr. Trowbridge, with certain modifications by Mr. Hill. In this instrument the whole and not a part of the current was passed through the coils. A brief reference to the Brush machine, and at greater length to the Bürgin machine, followed by a short description of the Brush, Siemens, Brockie, and Crompton lamps, concluded a most interesting lecture.

Joel's Lamp at Newcastle.—During the past few days an exhibition of the improved incandescent electric light has been made in the warehouse and shop of Messrs. George Angus and Co., Grainger-street West, Newcastle, by the inventor and patentee, Mr. Henry Joel, of London. The lights at Messrs. Angus's shop are worked from a small Siemens dynamo machine, driven by the steam engine used by Messrs. Angus in their factory, the length of the connecting wire being over two hundred and fifty yards. Five lights are fitted in the shop and one in the office. The lamps are fitted with chandelier suspensions similar to gas fittings, and with taps for turning the lights off and on. The light is very steady, of a pure white colour, and of good power, each lamp, it is estimated, being equal to about seven gas burners of the best type. It is produced from the heating to incandescence of the end of a thin carbon pencil, which, continuously fed up through a simple and special arrangement of contact clamping jaws, presses against a terminal and fixed cylinder of copper. The light emanates from the short length of the carbon pencil (about three-quarters of an inch) between the clamping jaws and the copper top, but principally from the fine point of the carbon pencil in contact with the copper electrode. The action of the current of electricity causes the carbon pencil to point itself in a somewhat interesting and peculiar manner. The end of the carbon being intensely heated, slightly curls over and forms a little mushroom top, the edges of which gradually burn away simultaneously with their replenishment by the pressure of the carbon, as already described. The means for renewing the carbons every seven or fourteen hours are very simple, while the copper electrode lasts for a very long time. One of the distinctive features of Mr. Joel's light is that there is no necessity for a vacuum, although it can also be burnt in a vacuum. The lamp is fitted with automatic safety arrangements, so that before it can be opened the electric current is shut off, and when the carbon pencil is all consumed the lamp is also shut off, so that all chance of accident is avoided.—*Newcastle Daily Chronicle.*

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IN QUARTERS.

ADEN.

There no cool grot invites the travellers gaze,
No pleasant sward, no waving trees adorn ;
No murmuring stream meanders in a maze;
Its earth is ashes—and its breast forlorn.

Aden is, geographically, too well known to need description. Suffice it to say, it is situated in lat. 12 deg., 47 N long., 45 deg., 10′ E, in that part of the world known as Arabia Felix, to which it is connected by a narrow isthmus, and is the half-way house between Suez and Bombay. If we add that it is admirably fitted by nature for a half-way house between the bottom of the sea and a place fortunately not on the chart it will be sufficient.

On approaching from seaward, as the features of the coast one by one struggle into view, Râs Tarsbayne (on which the residence of the Governor stands) and adjacent Râs Baradli become sharply defined, awakening speculation as to the nature of the huge cluster of buildings that grace the latter eminence. Râs Baradli, bearing as it does the station and quarters of the Eastern Telegraph Company, is undoubtedly one of the landmarks of the place. Isolated from the more closely inhabited parts of Aden by a long stretch of rock and sand, terminated by ninety weary steps—steps that have been saluted with the varied objurgations of irate passengers until each stone may be said to claim its particular epithet—it commands interest and admiration, not only as the pioneer of commercial progress, of science, as a part of the great connecting link between England and the far east, and as an example of unflagging industry, but from its association with the South African lines, and the important service it is enabling the company to render to our country.

On entering the harbour the ship is immediately besieged by swarms of Somâli boys, who clamour loudly for backsheesh, supplementing the request with an offer to "have a dive," for a consideration.

Others (individuals with their hair encrusted with lime and clay) proffer shells and coral for sale, while the typical Israelite contributes his share of feathers and vociferation to the general din.

Here we are relieved from further annoyance by the timely arrival of some of our ubiquitous fellows, who, with the hand of experience, *quietly* put these gentry aside, and, after the usual libation, a due amount of hand shaking, and eager inquiries after the well-being of other members of our large family, a shore boat is hailed and we proceed to the Bunder.

Here we are ushered into a gharry—a frail and spidery structure—driven by a species of Black Care, whose frequent "tchoo-hi-hi" and "tchâ-ho-ho" admonishes the feeble quadruped to amended pace, and in due course arrive at the foot of our *bête noir*, the steps, which we surmount eventually.

The station buildings are four in number, viz., the office and electricians' quarters, the superintendent's quarters and staff mess, the staff quarters, and a range of workshops, cookhouses, &c., while a bungalow away on the hill side shelters the repose of the assistant superintendent.

Of the office it is sufficient to say that it is well appointed and efficient. Here communication is maintained between Suez and Bombay, on the translation system (both Bm. and Sz. No. 2 cables being duplexed), and with Durban, a mirror instrument representing the latter.

I may mention that the South African lines are also worked on the new translation system, which is found to give satisfaction.

The quarters are represented by a two-storied "bungalow," honeycombed, with arches and embrasures, and engirt on either floor by a spacious verandah, where on the weather side may be seen chairs of every description, from the severely studious down to the deliberately lazy.

The rooms are light, well ventilated (a desideratum in Eastern climates) and furnished, but as they are simply divided one from another by a thin wooden semi-partition—of remarkable acoustical properties by the way—privacy is a thing much lamented, but unknown. Probably the architect was of a sociable nature, and loved the sweet communion of souls. All very well—for the architect.

However, we have few secrets; and if a man *does* snore, missiles are always handy. It is rather awkward, however, for those on the staff who are freemasons. They are not unfrequently driven to mysterious conferences in the bathroom, or are to be seen in muttered conspiracy on the staircase, where, if interrupted, they smile pleasantly, and remark upon the state of the weather.

At four p.m., or a little after, everyone takes his tub and prepares for the evening meal. Occasionally there are visitors forthcoming, but as a general rule the dinner is very quiet, and the place deserted after seven p.m. For those who care to stay at home there is a well filled library, a number of newspapers, &c., and an excellent billiard table.

The office having claimed its contingent, we stroll down Aden's only road to Steamer Point—or, more properly, Tâwâhi—and on to the Prince of Wales' Crescent, a semi-circle of Parsee shops, where so-called *curios* and European goods are sold at a hundred or so per cent. profit, and a "S. and B." can be obtained if desired. Of these shops, Cowasfee's is perhaps the best, and certainly the most widely known; others are only remarkable for their sameness—Sarabjee, Muncherjee, Pallonjee, Eduljee, and all the other "jees" are identical, in their persons, their goods, and their chicanery. The crescent also boasts of two hotels and a Café Concert (commonly called the kaife) where damsels discourse sweet (?) music to an appreciative audience. Here, too, we have the civilised "jee"—the jee of society—resplendent in ill-fitting black, and armed with English language and Anglo-Indian assurance. *Asperius nihil est humili, cum surgit in altum.*

Aden possesses but few features of interest. The town proper is some five miles from Tâwâhi, and is only to be reached at a ruinous expense, and almost at the risk of one's neck. The main pass gate, which must be entered in order to gain the precincts of the camp or town, is situated on a steep hill—a painful ascent, truly—and after struggling down the declivity that keeps up the unities on the other side, there is little else but whitewash and rock to be seen.

The tanks are interesting, and are well worth a visit; but the eye soon gets wearied of the glare of the white houses and the heat and gloom of the black lava rocks encircling the town; and a very cursory inspection satisfies curiosity.

The population consists, mainly, of Somâlis, Arabs, Parsees, Jews, and a crowd of Hindoos of different smell. The Somâlis men are finely proportioned, and, indeed, handsome, and their manner of draping the few yards of calico that constitutes their summer and winter attire is strongly suggestive of Macbeth in a sheet. The women are rather pretty, have beautiful teeth, and are naturally industrious. The Somâlis, however, are said to be a quarrelsome and thievish race.

The men are usually employed as gharry wallahs, boatmen, &c., and, on the principle I presume of setting a thief to catch a thief, there are large numbers of them in the police force.

Vegetation is scanty, consisting principally of a few desert plants and shrubs—shrubs with their branches twisted and gnarled, and garnished with a dearth of spring leaves—asserting themselves defiantly, as if embittered by continual contest with the ungrateful soil.

We tried the experiment of transplanting a few selected specimens from a neighbouring valley, and among them the Adenium Obesum, a gaunt trunk surmounted by a few leaves and a rather pretty cluster of flowers. The jatropha spinosa, and one or two others of a like nature, lend quite an air of sylvan repose (!) to otherwise arid ground.

Apart from these, I believe that a few Eupharbiaceæ are all that Aden produces.

Some twenty or thirty miles up country, however, at Lâhej, Behi Ahmed, and other places, the soil is fertile; and large quantities of jowaree and other cereals are grown and brought into Aden daily during the season.

The climate is said not to be absolutely unhealthy, but it is very trying to Europeans, a change of air being necessary every two or three years. During the south-west monsoon the heat is oppressive, more especially by night, since the thermometer scarcely shows a degree of difference between noon and midnight. A breeze, however, springs up about two a.m., and sleep is possible. The worst months are May (when the change of monsoon produces utter calm) and September.

Enjoying, however, the blessings of good health, and secure in the assurance that, should sickness appear amongst us, the remedial measures of the Company have always been prompt and efficacious, the vicissitudes of climate do not trouble us to any very great extent.

Our servants are of divers nationality and colour. Within the last five minutes an Arab has looked in for orders, a Seedi brought the usual chota lazaree, a Hindoo removed the cup, and a Somâli whitewashed my boots, while a Chinaman is at present dodging round the walls intent upon putting up something. By and by he will ask me—"Spoose you wanted one littlee piecee vood, one fingeree muchee so long." And an interesting colloquy in the same language will ensue. Nice man, but vague.

Our daily life during the hot season is characterised by a good deal of monotony. In time we learn to look forward, as a species of mild excitement, to the advent of the mails and the dhobey, the latter being interesting by reason of his numerous defalcations and the vehemence of his defence thereof.

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In the cold weather, however, out-door amusements claim a large share of our time and attention. We have two cricket clubs, and, thanks to a genial and official neighbour, an excellent pitch and ground, the latter provided with two commodious sheds. Here we practice twice a week, and play occasional matches. Adjacent there is a well-kept tennis court, much loved by its supporters, and I hear that a rifle range is, among other projects, on the *tapis*.

In conclusion, although Aden's warmest partisan can neither express unqualified approbation of its desirability as a place of residence or extol the health-giving properties of its climate, yet there are many worse places on our great highway. No doubt the fact of living happily together, with that Mark Tapleyan disregard of petty discomforts for which I think our cosmopolitan staff is remarkable, has much to do with contentment. Not a little, however, of our present comfort may be ascribed to the Company's forethought and anxiety for our welfare.

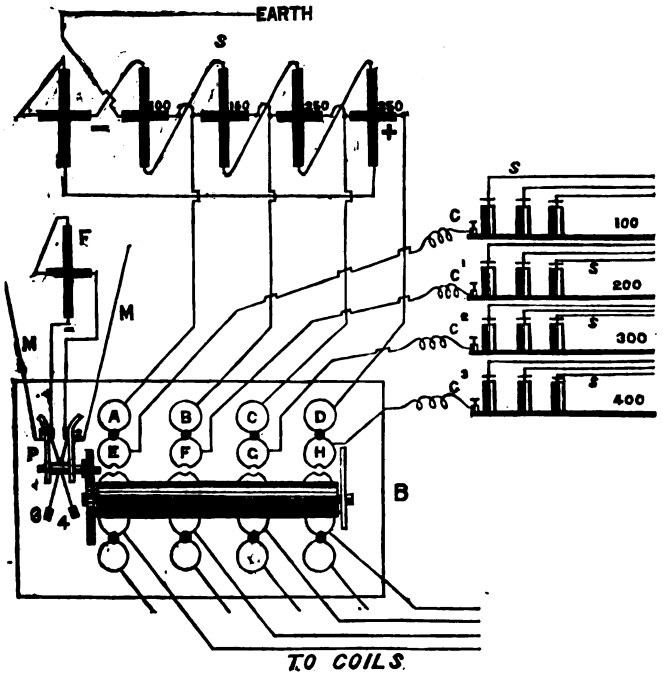
I should have mentioned that a large sum of money has been expended in reclaiming the rocky ground in the vicinity of the station, and the improvement is very marked. Where huge boulders and unsightly *débris* offended the eye, and rendered walking dangerous, is now a smooth and pleasant way.

Altogether, I am sure that those of our staff whose lines may hereafter fall in Aden will find but little cause to regret their stay—In Quarters. A. E. B.

MACHINE CURRENTS*.

BY F. W. JONES.

From the success that is attending the use of the electric currents furnished by dynamo machines in producing power and light, and in electro-plating operations, it is not surprising that extraordinary efforts are being made to introduce these currents generally into the telegraph system of the country, and supplant a very cumbersome and troublesome system of batteries. With characteristic foresight, the Western Union Telegraph Company have for some time been conducting a series of thorough experiments in their main office, New York, with a view of arriving at some results on which to base a judgment of the relative value of machine and battery currents, and at the present time there is a strong probability that the dynamo machine will entirely take the place of the Callaud batteries in the larger offices. Mr. Stephen D. Field, a well-known electrician, is engaged in arranging his system of applying currents from one or more Siemens machines to the Morse telegraph circuits, and in conjunction with Mr. G. A. Hamilton, electrician of the company, has arrived at very flattering results. The experimental arrangement of the system is shown in the diagram. S represents a



series of five Siemens machines, the vertical bars representing their field magnets and the horizontal bars their armatures. The machine on the extreme left is used to feed the field magnets of the whole series. The armatures of the four machines on the right are connected together, as shown in the diagram, the free end of one being to earth. A switch board, B, having twenty brass discs, 1·5″ diameter, with holes and pegs ·5″, has its upper row of discs connected to four wires running to the armatures of four machines respectively, which furnish a current of about 100 volts at disc A, 150 volts at disc B, 250 at disc C, and 350 at disc D. The discs E, F, G and H are connected with the brass bed plates of resistance coils C, C_1, C_2, C_3, respectively. Each bed plate serves as a common terminal for one end of resistance of each coil placed thereon. Wires are carried from the upper terminal of these coils to the switch board, where connections are made with the lines, which are connected to C, C_1, C_2 and C_3, according to their resistance. The coils are made of cylinders of prepared plaster of Paris, and the fine resisting wire is wound spirally in a groove upon its surface, about twenty convolutions per inch.

The two lower rows of discs are similarly connected to a second series of machines and resisting coils, arranged in the same manner as the first series, excepting that an opposite polarity of current is given. To the four discs of the middle row are connected wires running to the armatures of a spare series of machines, of which F represents the machine for feeding the field of the other four, not shown in the diagram. The wires from F, and also the two ends of the wire connecting together the field magnets of the four machines, are brought to a pole changer, P, on the left of the discs; by raising the springs 1 and 2, and turning them back to connect at 3 and 4, will reverse the current of the feeder through the field magnets, and give an opposite polarity to the middle discs. The same movement of the springs also moves a slide over the holes of either the upper or lower discs, connected to the coils so that opposite poles of two series of machines cannot be pegged together. The fourth potential of 350 volts is intended for quadruplex working.

Up to the present time the greatest difficulty encountered in applying the currents was in reducing the spark and obviating the danger of fire. The plaster coils have admirably made these difficulties easy to surmount, and by the employment of superior insulated conductors and a proper location of the coils, no trouble can easily arise.

The resistance coils C are about 100 ohms; C_1 200, C_2 300, C_4 400. Only three coils are shown in each series in the diagram, but they may be extended in number to meet the number of lines it is desired to work. In the metropolitan system the circuits lowest in resistance have a wedge of resistance inserted in them at the switch, in order to equalise the currents. It is interesting to note that applying a ground to the line terminal of one of the coils does not perceptibly affect the strength of currents flowing through the other coils to other circuits. Three upright engines are used, receiving power from the basement of the building, where a large pressure of steam is always kept for various purposes.

The system, being in an experimental and transitory stage, does not admit of an exhaustive report. Our readers may expect shortly to have the subject more critically treated, and the interesting applications of the currents to quadruplexes and local circuits illustrated, together with an estimate of cost.

* From the *Journal of the American Electrical Society*.

DIRECT SPANISH TELEGRAPH COMPANY (LIMITED).

Report of the Directors for the half year ending 31st December, 1880, to be presented at the general meeting of shareholders, to be held on Thursday, the 31st March, 1881.—1. The shareholders will no doubt observe with satisfaction that the accounts for the half year ending 31st December, 1880, show a balance to the credit of profit and loss of £6,962 6s. 3d. 2. The traffic receipts for the half year are £1,652 14s. in excess of those for the corresponding half year of 1879. 3. Both cables have continued during the whole six months, and are now, in perfect condition. 4. The underground line to connect the landing of the Bilbao cable at the Lizard with the Post Office at Falmouth has been completed in the most satisfactory manner, and the company's new offices in the Post Office Buildings at Falmouth were opened on 12th January last. The accounts for the construction of this line are not yet complete, but the directors expect that the total cost will only slightly exceed the estimate of £2,500. The directors are happy to be able to state that the arrangements they succeeded in making with the French and Spanish Telegraph Administrations for a reduced rate over the Barcelona cable, which came into force on 1st January last, have considerably increased the net earnings of that cable. After paying the dividend on the preference shares for the half year there will remain £4,040 16s. 3d., out of which the directors recommend that the arrears of 10s. per share, amounting to £2,921 10s. still due on the preference shares, be paid, and the balance (£1,119 6s. 3d.) added to the reserve fund, which will then amount to £3,197 18s. 8d. The dividend warrants in payment of the preference dividend and arrears will be issued as soon as remittances from Spain for the balances of message accounts to 31st December last are received. Mr. Bannatyne and Mr. Etlinger are the directors retiring by rotation and being eligible offer themselves for re-election. Mr James Cowan is eligible for election as auditor for the present year.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

All communications to be addressed to 396, Strand, London, W.C.

We cannot undertake to return drawings or manuscripts, and must, therefore, request Correspondents to keep copies.

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TO OUR READERS.

Arrangements have now been completed whereby from our next issue a permanent increase of at least four pages will be added to each number.

ELECTRICITY AND CRIME.

The recent murder of the Czar of Russia has turned the attention of the general public to the terrible uses which may be made of nitro-glycerine and other explosives; but electricity has also been pressed into the service of the Nihilists, and the part it has been called upon to play is naturally one of peculiar interest to electricians.

It will be remembered that, in the Moscow mine sprung below the railway when the train supposed to contain the Czar was passing, the explosive charge was fired by means of an electric fuse, communicating by underground wires with a battery contained in the house of the conspirators, situated close by. Again, in the Little Garden Street mine recently laid open another electric exploder was found. This mine was prepared in case the attempt on the Emperor's life by means of bombs should fail, and it was laid under the middle of the street along which he was accustomed to drive on his way to and from the parades in the Michael Riding School. In January last a cellar shop opposite the spot was taken by a peasant named Kobosew and his wife, who established a dairy in it. The suspicions of the police were aroused concerning the pair owing to the woman's habit of smoking superior cigarettes, and the premises were searched the day before the assassination took place, on the pretext that they were damp and unhealthy, but nothing noteworthy could be found. On the Wednesday following the dire event, however, the couple were found to have decamped, and a second investigation of the premises revealed a subterranean gallery lined with wood, two and a half feet wide, and sunk twenty-one feet below the level of the street. A heavy charge of dynamite was laid along this gallery under the roadway, and an electric battery, ready mounted, was found in connection with insulated wires running to the explosive. It was clear that the mine was to have been fired by the electric current from this battery, and it also seems evident that the pseudo milkman and his wife had dedicated their lives to the crime, for the charge of dynamite was sufficient to blow up not only the Emperor's carriage and suite but the houses on both sides of the street. No signs were found, so far as we can learn, of wires leading to a place of greater safety from which the mine could have been fired with impunity to the operators.

It is proof of the terrible earnestness of these conspirators that they do not seem to care whether they themselves escape or not. The Russian, like his Oriental kinsman, is far more callous of death than the Western European; but probably no sane man would risk annihilation if he could avoid it. The electric current will travel wherever wires will lead it, and hence it is peculiarly adapted to fire mines without any danger to the firing party. In addition to this property of operating from a distance it has the power of instantaneous action, so that a person situated at a secure look-out can make the circuit at the proper moment and explode the mine. For attempts such as those on the Moscow train, or the rapidly moving carriage of the Emperor, electricity was, indeed, the only agent which could have served the purpose, because of its property of being transmitted from a convenient station at a given instant. A burning match would not have answered; it would have been too slow, and the critical moment would in all likelihood have been lost.

With electricity in their employment the Nihilists have, indeed, become terrible enemies, and it is difficult to see how any public life which they have doomed is safe. Poison can be guarded against, ordinary explosions by means of fuses can only serve in cases where the victim remains for a time in one place; but explosions by means of electricity can actually do their deadly work when the victim is, so to speak, upon the wing. Whether in the seclusion of his own home or travelling by the public road or rail, the condemned man may be said to carry his life in his hands. For it will always be impossible for the utmost ingenuity or care to find out where the next attack will be made.

There is no legal remedy for this state of things? Dynamite and nitro-glycerine are useful compounds for engineering works, and their industrial application cannot be impeded because certain miscreants turn them to evil purposes. No one would dream of imposing any check upon the sale of electric batteries and mine exploders. But as electricity cannot be kept out of the hands of criminals there is a growing impression abroad that it ought to be employed for their chastisement. No tortures of the Inquisition, no rack or thumbscrew, can parallel the excruciating agonies which could be inflicted on the throbbing nerves of a person subjected to the refined and scientific cruelties of the electric shock. "Now creatures in the likeness of men" (write

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the authors of the *Unseen Universe*, believed to be Professors Tait and Balfour Stewart), "Now creatures in the likeness of men vent their despicable passions in murderous assaults upon women and children. But science hints at an effectual ure. It is probable that before many years are passed, electricity, which by some mysterious means enables our nerves to call our muscles into play, which enables us to converse with one another at distances of thousands of miles, which electro-plates the teaspoon and illumines the lighthouse, will be called upon by an enlightened legislature to produce absolutely indescribable torture (unaccompanied by wound or even bruise) thrilling through every fibre of such miscreants." For our own part, however, we see nothing to be gained but much to be lost by the application of the "scientific method" to punishment of criminals; and it is with feelings akin to disgust that we learn while writing these lines that electrical torture has been inflicted upon the latest of regicides in order to make him name his accomplices. This is a sort of scientific martyrdom which is neither salutory to those who suffer nor wholesome for those who impose it. If assassination is murder, it is a rude business which calls for treatment equally rude; and at all events there is no call for science to volunteer in the ugly ranks of the executioners. Now and again we hear of suggestions for taking people off "sharp" by means of electricity. It is true that it could not be done so neatly or so expeditiously by any other method. But we do not envy the electrical engineer who might be asked to furnish an estimate for doing to death so many criminals at one fell stroke; and we gravely apprehend that science would risk being discredited by responding to such an invitation. We have all read with some sort of pride the story of the man who was restored to life after a clumsy hangman had done his worst upon him. To such beneficent work should science devote itself; none but the thoughtless or ignorant will hold science responsible for the malignant uses to which cruelty or recklessness may turn its discoveries; but if anything would justify a reactionary prejudice against scientific men it would be their associating themselves with the brutal, though necessary, business of retaliatory justice.

OURSELVES.

A social gathering—the first of a series it is hoped—of the proprietors of and contributors to *The Electrician* was held on Wednesday last, at the Criterion, Messrs. Spiers and Pond's, an excellent dinner being served by them in their usual admirable style. Mr. J. Pender, M.P., presided, with Sir J. Anderson as the vice president. The gentlemen present were:—Mr. A. J. S. Adams, Professor W. E. Ayrton, Mr. C. H. W. Biggs, Mr. Brooks (Philadelphia), Mr. W. C. Cartwright, M.P.; Mr. Latimer Clark, Mr. Crompton, Mr. Brockwell Dalton, Mr. Arenberg (New York), Mr. Desmond G. FitzGerald, Mr. J. E. H. Gordon, Professor D. E. Hughes, Mr. J. Laister, Dr. O. J. Lodge, Mr. A. R. H. Moncrieff, Dr. A. Muirhead, Mr. J. Munro, Mr. W. H. Parker, Professor J. Perry, Mr. W. H. Preece, Mr. H. E. Saunders, Mr. J. T. Sprague, and Mr. T. P. Bruce Warren.

In the course of the evening Mr. J. Pender, M.P., recounted some of his earlier experiences in relation to the commercial aspects of submarine telegraphy, stating that while the scheme of Atlantic telegraphy was pooh-poohed by eminent authorities, he had given it a hearty allegiance directly he understood what electricians—in the shape of Sir W. Thomson—could do when the cable was laid. Mr. Pender and Sir J. Anderson both expressed their firm conviction that electrical science was in its infancy, and had a grand future before it, with which Professor Ayrton, Mr. Latimer Clark, and the other speakers cordially agreed.

Mr. Brooks stated that his modesty would not allow him to claim everything for America, and in fact his quaint and happy allusions to workers, both in America and England, were highly appreciated. Mr. W. H. Preece referred in graceful terms to our efforts to establish an organ worthily representing the progress of electrical science, wishing us a hearty *bon voyage*. The toasts of "The Staff," "The Contributors," "Absent Electricians of All Lands," having been enthusiastically received, the proceedings of the evening concluded with a hearty vote of thanks to Mr. Pender for presiding.

CORRESPONDENCE.

EXPERIMENTS WITH RADIANT ENERGY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In your most interesting account of Mr. Preece's experiments it does not appear that he ever employed a telephone directly for the purpose of indicating what was going on inside the air case, but seems to have preferred to use a microphone. I venture to suggest that for this class of disturbance a microphone is not always to be trusted, whilst the tympanum of a telephone never fails. Roughly, my idea is that one end of the air case might be closed by a metal disc, or membrane with a bit of metal affixed, forming part of a telephone connected, of course, to a second receiving telephone. From my own observation I know that the microphone is not affected by certain kinds of motion, and at all events it is more troublesome than the telephone.

AN AMATEUR.

March 20th, 1881.

ELECTRIC BREAKS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I observe that it has been suggested at the Society of Telegraph Engineers to attach magneto-electric breaks to the driving-wheel of the locomotive. There may be electrical possibilities beyond my knowledge rendering this suggestion a feasible one; but, if so, why not attach the gear of the existing breaks to the driving wheel? The answer is obvious; but does not the same answer apply to electrical attachments?

March 18th, 1881. ENGINEER.

ELECTRICITY AND NEURALGIA.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: You will see by a paragraph which I enclose that the "Family Physician" recommends, under certain conditions, the application of electricity in cases of neuralgia. Can any of your readers inform me whether trustworthy investigations have ever been published respecting the action of electricity upon the human body? Is it in the nature of electrolysis, or is it merely a counter-irritant? Has anyone yet explained *why* a current hurts us, and what results from the hurting?—Yours, &c.,

March, 1881. QUERY.

OVERHEAD WIRES.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The extra precautions reported to be taken by the military and police for the protection of our public buildings may readily be frustrated by the agency of the overhead telegraph and telephone wires. Any person maliciously disposed could by such means arrange the carriage and discharge, by clockwork, into the very centre of a large building, of sufficient dynamite to effectually blow it up. The Bank of England is favourably circumstanced for immediate annihilation.—Yours, &c.,

27, St. Mary's-road, N. RICHARD HERRING.

MR. HALL'S EXPERIMENTS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Permit me, with reference to an abstract of Mr. E. H. Hall's paper which appeared in your journal for the 26th February, to remind you of some experiments made by me in 1879, which may throw some light on the phenomenon of which he speaks.

The induction spark, as you know, and as I showed in 1874,

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is composed of two different electric streams, one of which has its origin in the spark, properly so-called, and which shows itself in the shape of a shaft of white flame, the other of which forms round this stream a *luminous envelope* of a dull red colour, which I have named the *aureola*. Through the agency of an air current or by magnetic action it is easy to separate these two streams, and to cause them to traverse different circuits, so that we can study their character. Thus we find that the aureolic stream has all the peculiarities of *quantity currents*, whilst the other resembles *static electrical discharges*. The aureola owes its origin to the gaseous envelope which surrounds the shaft of flame, and which, being heated to red-heat by the spark, forms a comparatively good conductor. Now this conductor being flexible and luminous, shows perfectly all the reactions taking place in the current traversing it, and, in consequence, it is sensitive to the reactions taking place between magnets and currents, and even between currents themselves. If, for instance, we cause an induction spark to pass between the poles of an electro-magnet, the result of the coils in the magnetic helix parallel to the discharge, should, according to Ampère's law, attract or repel the aureolic stream. Now this is, in fact, what happens, for it is projected either above or below the shaft of flame in the shape of a circular sheet in the same plane as the magnetic resultant, corresponding to the neutral line of the magnet.

If we make the discharge follow the axial line, *i.e.*, the line connecting the two poles of the electro-magnet, the magnetic resultant then cuts the discharge perpendicularly, and the reciprocal actions of the two currents are similar to those of two currents crossing at right angles, as in Mr. Hall's experiment. Under these conditions the luminous aureola assumes the form of a screw propeller, for the reciprocal actions between the two currents are of opposite signs in the corresponding angles, and of similar signs in the opposite angles of the cross thus formed by the two currents. If by means of an air current properly directed, and of two conductors placed in front of the two opposite portions of the luminous screw thus projected, we open an easier path to the aureola than that of the gaseous medium, we have in the circuit of the two conductors placed perpendicularly to the shaft of flame a current similar to that obtained by Mr. Hall.

In the experiment of which I am speaking, the direction of the screw varied according to the magnetic polarity of the magnet, as can be easily understood, since the reactions between the currents were then reversed. In order that the experiment may be successful, it is necessary that the terminals between which the spark passes should not be exactly in the same line; there should be a slight inclination of the line of discharge to the axial line of the electro-magnet.—Yours, &c.,

TH. DU MONCEL.

MOLECULAR ELECTRO-MAGNETIC INDUCTION.*

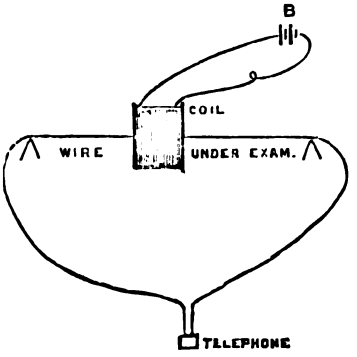
BY PROFESSOR D. E. HUGHES, F.R.S.

The induction currents balance which I had the honour of bringing before the notice of the Royal Society† showed how extremely sensitive it was to the slightest molecular change in the composition of any metal or alloy, and it gave strong evidence of a peculiarity in iron and steel which its magnetic properties alone failed to account for. We could with all non-magnetic metals easily obtain a perfect balance of force by an equivalent piece of the same metal, but in the case of iron, steel, and nickel it was with extreme difficulty that I could obtain a near approach to a perfect zero. Two pieces of iron cut off the same bar or wire, possessing the same magnetic moment, never gave identical results; the difficulty consisted, that notwithstanding each bar or wire could be easily made to produce the same inductive reaction, the time during which this reaction took place varied in each bar; and although I could easily change its balancing power as regards inductive force by a change in the mass of the metal, by heat or magnetism, the zero obtained was never equal to that obtained from copper or silver.

This led me to suppose the existence of a peculiarity in magnetic metals which could not be accounted for except upon the hypothesis that there was a cause, then unknown, to produce the invariable effect.

Finding that it would be impossible to arrive at the true cause without some new method of investigation, which should allow me to observe the effects from an electrical circuit, whose active portion should be the iron wire itself, I constructed an apparatus or electro-magnetic induction balance, consisting of a single coil reacting upon an iron wire in its axis, and perpendicular to the coil itself; by this means the iron or other wire itself became a primary or secondary, according as the current passed through the coil or wire. Now, with this apparatus we could induce secondary currents upon the wire or coil, if the coil was at any angle, except when the wire was absolutely perpendicular; in this state we could only obtain a current from some disturbing cause, and the current so obtained was no longer secondary but tertiary.

The whole apparatus, however, is more complicated than the general idea given above, as it was requisite not only to produce effects but to be able to appreciate the direction of the electrical current obtained, and have comparative measures of their value. In order to fully understand the mode of experiments, as well as the results obtained, I will first describe the apparatus employed.



(The arrangement of the apparatus is shown in the figure.)

The electro-magnetic induction balance consists—1st, of an instrument for producing the new induction current; 2nd, sonometer or balancing coils; 3rd, rheotome and battery; 4th, telephone.

The essential portion of this new balance is that wherein a coil is so arranged that a wire of iron or copper can pass freely through and form its axis. The iron or copper wire rests upon two supports 20 centims. apart; at one of these the wire is firmly clamped by two binding screws; the opposite end of the wire turns freely on its support, the wire being 22 centims. long, having 2 centims. projection beyond its support, in order to fasten upon it a key or arm which shall serve as a pointer upon a circle giving the degrees of torsion which the wire receives from turning this pointer. A binding screw allows us to fasten the pointer at any degree, and thus preserve the required stress the time required.

The exterior diameter of the coil is 5½ centims., having an interior vacant circular space of 3½ centims., its width is 2 centims. Upon this is wound 200 metres of No. 32 silk-covered copper wire. This coil is fastened to a small board so arranged that it can be turned through any desired angle in relation to the iron wire which passes through its centre, and it can also be moved to any portion of the 20 centims. of wire, in order that different portions of the same wire may be tested for a similar stress.

The whole of this instrument, as far as possible, should be constructed of wood, in order to avoid, as far as possible, all disturbing inductive influences of the coil upon them.

The iron wire at its fixed end is joined or makes contact with a copper wire, which returns to the front part of the dial under its board and parallel to its coil, thus forming a loop, the free end of the iron wire is joined to one pole of the battery, the copper wire under the board is joined to the rheotome and thence to the battery.

The coil is joined to the telephone; but, as in every instance we can either pass the battery through the wire, listening to its inductive effects upon the wire, or the reverse of this, I prefer, generally, in order to have no voltaic current passing through the wire, to join the iron wire and its loop direct to the telephone, passing the voltaic current through the coil.

FIG. 1

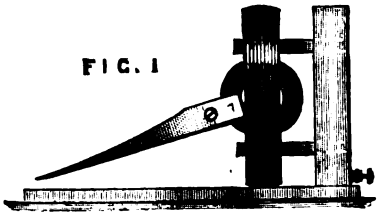
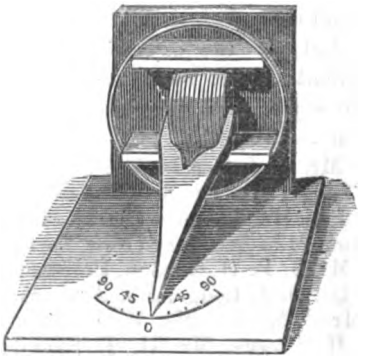


FIG. 2



(The figures show two views of the instrument.)

In order to balance, measure, and know the direction of the new induction currents by means of a switching key, the sonometer* I described to the Royal Society is brought into the circuit. The two exterior coils of the sonometer are then in the circuit of the battery, and of the coil upon the board containing the iron wire or stress bridge. The interior or movable coil of the sonometer is then in the circuit of the iron wire and telephone. Instead of the sonometer constructed as described in my paper to the Royal Society, I prefer to use one formed upon a principle I described in *Comptes Rendus* December 30, 1878. This consists of two coils only, one of which is smaller and turns freely in the

* A Paper read before the Royal Society.
† *Proceedings Royal Society*, vol. 29, p. 56.

* *Proceedings Royal Society*, vol. 29, p. 65.

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centre of the outside coil. The exterior coil being stationary, the centre coil turns upon an axle by means of a long (20 centims.) arm or pointer, the point of which moves over a graduated arc or circle. Whenever the axis of the interior coil is perpendicular to the exterior coil, no induction takes place, and we have a perfect zero: by turning the interior coil through any degree we have a current proportional to this angle, and in the direction in which it is turned. As this instrument (*see* preceding figures) obeys all the well-known laws for galvanometers, the readings and evaluations are easy and rapid.

If the coil upon the stress bridge is perpendicular to the iron wire, and if the sonometer coil is at zero, no currents or sounds in the telephone will be perceived, but the slightest current in the iron wire produced by torsion will at once be heard; and by moving the sonometer coil in a direction corresponding to the current, a new zero will be obtained, which will not only balance the force of the new current but indicate its value. A perfect zero, however, will not be obtained with the powerful currents obtained by the torsion of 2 milims. diameter iron wire. We then require special arrangements of the sonometer which are too complicated to describe here.

The rheotome is a clockwork, having a rapid revolving wheel which gives interruptions of currents in fixed cadences in order to have equal intervals of sound and silence. I employ four bichromate cells or eight Daniell elements, and they are joined through this rheotome to the coil on the stress bridge, as I have already described.

The magnetic properties of iron, steel, nickel, and cobalt, have been so searchingly investigated by ancient as well as modern scientific authors, that there seems little left to be known as regards its molar magnetism. I use the word molar here simply to distinguish or separate the idea of a magnetic bar of iron or steel magnetised longitudinally or transversely from the polarised molecules which are supposed to produce its external magnetic effects.

Molar magnetism, whilst having the power of inducing an electric current in an adjacent wire, provided that either has motion or a change in its magnetic force, as shown by Faraday in 1832, has no power of inducing an electric current upon itself or its own molar constituent, either by motion or change of its magnetic moment. Molecular magnetism (the results of which, I believe, I have been the first to obtain) has no, or a very feeble, power of inducing either magnetism or an electric current in an adjacent wire, but it possesses the remarkable power of strongly reacting upon its own molar wire, inducing (comparatively with its length) powerful electric currents in a circuit of which this forms a part.

In some cases, as will be shown, we may have both cases existing in the same wire; this occurs when the wire is under the influence of stress, either external or internal. It would have been most difficult to separate these two, as it was in my experiments with the induction balance without the aid of my new method.

Ampère's theory supposes a molecular magnetism or polarity, and that molar magnetism would be produced when the molecular magnetism became symmetrical; and his theory, I believe, is fully capable of explaining the effects I have obtained, if we admit that we can rotate the paths of the polarised molecules by an elastic torsion.

Matteucci made use of an inducing and secondary coil in the year 1347,* by means of which he observed that mechanical strains increased or depressed the magnetism of a bar inside this coil.

Wertheim published in the *Comptes Rendus*, 1852,† some results similar to Matteucci; but in the *Annales de Chimie et de Physique*, 1857,‡ he published a long series of most remarkable experiments, in which he clearly proves the influence of torsion upon the increment or decrement of a magnetical wire.

Vilari showed § increase or diminution of magnetism by longitudinal pull according as the magnetising force is less or greater than a certain critical value.

Wiedermann,‖ in his remarkable work, "Galvanismus," says that an iron wire through which an electric current is flowing becomes magnetised by twisting the wire. This effect I have repeated, but found the effects very weak, no doubt due to the weak battery I use, viz., four quart bicromate cells.

Sir W. Thomson shows clearly in his remarkable contribution to the *Phil. Transactions Royal Society*, entitled "Effects of Stress on the Magnetisation of Iron, Nickel, and Cobalt,"¶ the critical value of the magnetisation of these metals under varying stress, and also explains the longitudinal magnetism produced by Wiedermann as due to the outside molar twist of the wire, making the current pass as in a spiral round a fixed centre. Sir William Thomson also shows clearly the effects of longitudinal as well as transversal strains, both as regards its molar magnetism and its electric conductivity.

My own researches convince me that we have in molecular magnetism a distinct and separate form of magnetism from that when we develop, or render evident, longitudinal or transversal magnetism, which I have before efined as molar.

Molecular magnetism is developed by any slight strain or twist other than longitudinal, and it is only developed by an elastic twist; for, however much we may twist a wire, provided that its fibres are not separated, we shall only have the result due to the reaction of its remaining elasticity.

If we place an iron wire, say 20 centims. long, 1 millim. diameter, in the axis of the coil of the electro-magnetic balance, and if this wire is joined, as described, to the telephone, we find that on passing an electric current through the inducing coil no current is perceptible upon the iron wire; but if we give a very slight twist to this wire at its free end—one-eighteenth of a turn, or 20 deg.—we at once hear, clear and comparatively loud, the currents passing the coil; and although we only gave a slight elastic twist of 20 deg. of a whole turn, and this spread over 20 centims. in length, making an extremely slight molar spiral, yet the effects are more powerful than if, using a wire free from stress, we turned the whole coil 40 deg. The current obtained when we turn the coil, as just mentioned, is secondary, and with the coil at any angle any current produced by its action, either on a copper, silver, iron, or steel wire; in fact, it is simply Faraday's discovery, but the current from an elastic twist is no longer secondary under the same conditions, but tertiary, as I shall demonstrate later on. The current passing through the coil cannot induce a current upon a wire perpendicular to itself, but the molecules of the outside of the wire, being under a greater elastic stress than the wire itself, they are no longer perpendicular to the centre of the wire, and consequently they react upon this wire as separate magnets would upon an adjacent wire. It might here be readily supposed that a wire having several twists, or a fixed molar twist of a given amount, would produce similar effects. It, however, does not, for in most cases the current obtained from the molar twists are in a contrary direction to that of the elastic torsion. Thus, if I place an iron wire under a right-handed elastic twist of 20 deg., I find a positive current of 50 deg. sonometer; but if I continue this twist so that the index makes one or several entire revolutions, thus giving a permanent molar twist of several turns, I find upon leaving the index free from any elastic torsion that I have a permanent current of 10 deg., but it is no longer positive, but negative, requiring that we should give an elastic torsion in the previous direction in order to produce a positive current. Here a permanent elastic torsion of the molecules is set up in the contrary direction to its molar twist, and we have a negative current, overpowering any positive current which should have been due to the twisted wire.

The following table shows the influence of a permanent twist, and that the current obtained when the wire was freed from its elastic torsion was in opposition to that which should have been produced by the permanent twist. Thus, a well-softened iron wire, 1 millim. in diameter, giving 60 deg. positive current for a right-handed elastic torsion of 20 deg., gave after 1 deg. ·80 permanent torsion a negative current of 10 deg.

1	complete permanent torsion	(right-handed)	negative	 10
2	,,	,,	,,	 15
3	,,	,,	,,	 15
4	,,	,,	,,	 16
5	,,	,,	,,	 12
6	,,	,,	,,	 10
7	,,	,,	,,	 5
8	,,	,,	,,	 4
9	,,	,,	,,	 3
10	,,	,,	,,	 3

At this point the fibres of a soft wire commence to separate, and we have no longer a complete single wire, but a helix of separate wires upon a central structure.

If now, instead of passing the current through the coil, I pass it through the wire, and place the telephone upon the coil circuit, I find that I obtain equally as strong tertiary currents upon the coil as in the previous case, although in the first case there was produced longitudinal electro-magnetism in the perpendicular wire by the action of the coil, but in the latter case none or the most feeble electro-magnetism was produced, yet in these two distinct cases we have a powerful current produced not only upon its own wire, but upon the coil, thus proving that the effects are equally produced both on the wire and coil.

If we desire, however, in these reversible effects to produce in both cases the same electromotive force, we must remember that the tertiary current when reacting upon its own short wire produces a current of great quantity, the coil one of comparatively higher intensity. We can, however, easily convert the great quantity of the wire into one of higher tension by passing it through the primary of a small induction coil whose resistance is not greater than one ohm. We can then join our telephone, which may be then one of a high resistance, to the secondary of this induction coil, and by this means, and without changing the resistance of the telephone, receive the same amount of force, either from the iron wire or the coil.

Finding that iron, steel, and all magnetic metals produce a current by a slight twist, if now we replace this wire by one of copper or non-magnetic metals we have no current whatever by an elastic twist, and no effects, except when the wire itself is twisted spirally in helix, and whatever current we may obtain from copper, &c., no matter if from its being in spiral or from not being perpendicular to the axis of the coils, the currents obtained will be invariably secondary and not tertiary. If we replace the copper by an iron wire, and give it a certain fixed torsion, not passing its limit of elasticity, we find that no increase or decrease takes place by long action or time of being under strain. Thus a wire which gave a sonometric force of 50 deg. at the first observation remained perfectly constant for several days until it was again brought to zero by taking off the strain it had received. Thus we may consider that as long as the wire preserves its elasticity, exactly in the same ratio will it preserve the molecular character of its magnetism.

It is not necessary to use a wire to produce these effects; still more powerful currents are generated in bars, ribbons, or sheets of iron. Thus, no matter what external form it may possess, it still produces all the effects I have described.

It requires a great many permanent twists in a wire to be able to see any effect from these twists, but if we give to a wire, 1 millim. diameter, forty whole turns (or until its fibres become separated) we find some new effects; we find a small current of 10 deg. in the same direction as its molar twist, and on giving a slight twist (20 deg.) the sonometric value of the sound obtained is 80 deg., instead of 50 deg., the real value of a similar untwisted wire; but its explanation will be found by twisting the wire in a contrary direction to its molar twist. We can now approach the zero but never produce a current in the contrary direction, owing to the fact that by the spiral direction, due to the fibrous molar turns, the neutral position of its molecules are no longer parallel with its wire, but parallel with its molar twist; consequently an elastic strain in the latter case can only bring the molecules parallel with its wire, producing no current, and in the first case the angle at which the reaction takes place is greater than before, consequently the increased value of its current.

The measurements of electric force mentioned in this paper are all sonometric on an arbitrary scale. Their absolute value has not yet been obtained, as we do not, at our present stage, require any except comparative measures.* Thus, if each wire is of 1 millim. diameter and 20 centims.

* *Comptes Rendus*, t. xxiv., p. 301, 1847.
† *Comptes Rendus*, t. xxv., p. 702, 1852.
‡ *Ann. de Chim. et de Phys.* (3), t. 1, p. 385, 3857.
§ *Poggendorff's Annalen*, 1868.
‖ Wiedermann's *Galvanismus*, p. 447.
¶ *Phil. Trans.*, May 6, 1878.

* 50 deg. sonometer has the same electromotive force as 0 deg. ·10 of a Daniell battery.

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long, all render the same stress in the axis of its coil. I find that the following are the sonometric degrees of value:—

	Deg.	
Soft iron	60	Tertiary current.
Hard drum iron	50	,, ,,
Soft steel	45	,, ,,
Hard tempered steel	10	,, ,,
Copper, silver, &c.	−0	
Copper helix, 1 centim. diameter, 20 turns in 20 centims.	45	Secondary currents.
Iron, spiral, ditto	45	,, ,,
Steel	45	,, ,,

The tertiary current increases with the diameter of the wire, the ratio of which has not yet been determined; thus, an ordinary hard iron wire of 1 millim. diameter giving 50 deg., one of 2 millims. diameter gave 100 deg.; and the maximum of force obtained by any degree of torsion is at or near its limit of elasticity, as if in same time we also pass this point, producing a permanent twist the current decreases, as I have already shown in the case of a permanent twist. Thus, the critical point of 1 millim. hard iron wire was 20 deg. of torsion, but in hard steel it was 45 deg.

Longitudinal strains do not produce any current whatever, but a very slight twist to a wire, under a longitudinal strain, produces its maximum effects; thus, 20 deg. of torsion being the critical point of iron wire, the same wire, under longitudinal strain, required but from 10 deg. to 15 deg. It is very difficult, however, to produce a perfect longitudinal strain alone. I have, therefore, only been able to try the effect of longitudinal strain on fine wires, not larger than 1 millim. in diameter, but as in all cases, no effect whatever was produced by longitudinal strain alone, I believe none will be found if absolutely free from torsion. The molecules in a longitudinal strain are equally under an elastic strain as in torsion, but the path of their motion is now parallel with its wire, or the zero of electric inductive effect, but the compound strain composed of longitudinal and transverse, react upon each other, producing the increased effect due to the compound strain.

The sonometer is not only useful for showing the direction of the current and measuring it by the zero method, but it also shows at once if the current measured is secondary or tertiary. If the current is secondary its period of action coincides with that of the sonometer, and a perfect balance, or zero of sound, is at once obtained, and its value in sonometric degrees given, but if the current is tertiary, no zero is possible, and if the value of the tertiary is 60 deg., we find 60 deg. the nearest approach to zero possible. But by the aid of separate induction coils to convert the secondary into a tertiary, a perfect zero can be obtained if the time of action and its force correspond to that which we wish to measure.

If I place a copper wire in the balance and turn the coils at an angle of 45 deg., I obtain a current which the sonometer gives a perfect zero at 50 deg., proving, as already said, that it is secondary. If I now replace the copper by an iron wire, the coil remaining at 45 deg., I have again exactly the same value for the iron as copper, viz., 50 deg., and in both cases secondary. Now, it is evident that in the case of the iron wire there was produced at each passage of the current a strong electro-magnet, but this longitudinal magnetism did not either change the character of the current or its value in force.

A most beautiful demonstration of the fact that longitudinal magnetism produces no current, but that molecular magnetism can act equally as well, no matter the direction of the longitudinal magnetism, consists in forming an iron wire in a loop, or taking two parallel but separate wires, joined electrically at their fixed ends, the free ends being each connected with the circuit, so that the current generated must pass up one wire and down the adjacent one. On testing this loop, and if there are no internal strains, complete silence or absence of current will be found. Now, giving a slight torsion to one of these wires in a given direction, we find, say, 50 deg. positive; twisting the parallel wire in a similar direction produces a perfect zero. Thus the current of the second must have balanced the positive of the first. If, instead of twisting it in similar directions, we twist in the contrary direction, the sounds are increased in value from 50 deg. positive to 100 deg. positive, showing, in this latter case, not only a twofold increase of force, but that the currents in the iron wires travelled up one wire and down the other, notwithstanding that both were strongly magnetic by the influence of the coil in one direction, and this experiment also proves that its molar magnetism had no effect, as the currents are equally strong in both directions, and both wires can double or efface the currents produced in each. If, instead of two wires we take four, we can produce a zero, or a current of 200 deg., and with twenty wires we have a force of 1,000 deg., or an electromotive force of two volts. We have here a means of multiplying the effects by giving an elastic torsion to each separate wire, and joining them electrically in tension. If loops are formed of one iron and one copper wire, we can obtain both currents from the iron wire, positive and negative, but none from the copper, its *rôle* is simply that of a conductor upon which torsion has no effect.

I have already mentioned that internal strains will give out tertiary currents, without any external elastic strain being put on. In the case of iron wire, these disappear by a few twists in both directions, but in flat bars or forged iron, they are more permanent; evidently, portions of these bars have an elastic strain, whilst other portions are free, for I find a difference at every inch tested. The instrument, however, is so admirably sensitive, and able to point out not only the strain, but its direction, that I have no doubt its application to large forged pieces, such as shafts or cannon, would bring out most interesting results, besides its practical utility. Great care is, therefore, necessary in these experiments that we have a wire free from internal strains, or that we know their value.

Magnetising the iron wire by a large steel permanent magnet has no effect whatever. A hard steel wire thus placed becomes strongly magnetic, but no current is generated, nor has it any influence upon the results obtained from molecular movement, as in elastic torsion. A flat wide iron or steel bar shows this better than iron wire, as we can here produce transversal, instead of longitudinal, but neither shows any trace of the currents produced by molecular magnetism. I have made many experiments with wires and bars thus magnetised, but as the effect in every case was negative when freed from experimental errors, I will not mention them; but there is one very interesting proof which the instrument gives, that longitudinal magnetism first passes through its molecular condition before and during the discharge, or recomposition of its magnetism. For this purpose, using no battery, I join the rheotome and telephone to the coil, the wire having no exterior circuit. If I strongly magnetise the two ends of the wire, I find by rapidly moving the coil, that there is a Faradaic induction of 50 deg. at both poles, but very little or none at the centre of the wire. Now, fixing the coil at the centre or neutral point of the wire, and listening intently, no sounds are heard, but the instant I give a slight elastic torsion to the free pole, a rush of electric tertiary induction is heard, whose value is 40 deg. Again, testing this wire by moving the coil, I find only a remaining magnetism of 10, and upon repeating the experiment of elastic torsion, I find a tertiary of 5. Thus we can go on gradually discharging the wire, but its discharge will be found to be a recomposition, and that it first passed through the stage I have mentioned.

Heat has a very great effect upon molecular magnetic effects. On iron it increases the current, but in steel the current is diminished. For experimenting on iron wire, which give a tertiary current of 50 deg. positive (with a torsion of 20 deg.), upon the application of the flame of a spirit-lamp, the force rapidly increases (care being taken not to approach red heat) until the force is doubled, or 100 positive. The same effects were obtained in either direction, and were not due to a molar twist or thermo-current, as if care had been taken to put on not more than 10 deg. of torsion the wire came back to zero at once on removal the torsion. Hard-tempered steel, whose value was 10 deg. whilst cold, with a torsion of 45 deg., became only a deg. when heated, but returned (if not too much heated) to 8 deg. when cold. I very much doubted this experiment at first, but on repeating the experiment with steel several times I found that on heating it I had softened the extreme hard (yellow) temper to that of the well-known blue temper. Now, at blue temper, hot, the value of steel was but 1 to 2 deg., whilst soft iron of a similar size gave 50 deg. of force cold, and 100 deg. at red heat. Now, as I have already shown that the effects I have described depend on molecular elasticity, it proves at least, as far as iron and steel are concerned, that a comparatively perfect elastic body, such as tempered steel, has but slight molecular elasticity, and that heat reduces it, but that soft iron, having but little molar elasticity, has a molecular elasticity of a very high degree, which is increased by heat.

The objects of the present paper being to bring the experimental facts before the notice of the Royal Society, and not to give a theoretical solution of the phenomena, I will simply add, that if we assume with Poisson, that the paths of the molecules of iron are circles, and that they become ellipses by compression or strain, and also that they are capable of being polarised, it would sufficiently explain the new effects.

Joule has shown that an iron bar is longer and narrower during magnetisation than before, and in the case of the transverse strain the exterior portions of the wire are under a far greater strain than those near the centre, and as the polarised ellipses are at an angle with the molecules of the central portions of the wire, its polarisation reacts upon them, producing the comparatively strong electric currents I have described.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices March 23.		Business Done Week Ending March 23. Highest.	Lowest.
Anglo-American	58,	½	57¾	54
Do. Preferred	86¾,	7¼	87	82
Do. Deferred	30½,	½	30¾	27½
Brazil Submarine	10½,	¾	10¾	10
Cuba	8¾,	9¼	8¾	8¾
Do. Preference	16¼,	¼	16¼	16¼
Direct Spanish	3¾,	4¼	4	4
Do. Preference	13¾,	14¼	14¼	13¾
Direct United States Cable	11,	¼	11¼	10¾
Eastern Telegraph	9 11-16,	13-16	9 13-16	9 9-16
Do. 6 per Cent. Preference	12¾,	¼	12¾	12¼
Do. 5 per Cent. Debentures, 1899	100,	2	104	104
Eastern Extension	10¼,	¼	10¼	10
German Union	10¼,	¼	10¾	10¼
Globe Telegraph and Trust Company	6,	¼	6¼	5¾
Do. Preference	12¼,	¼	12¾	12¼
Great Northern	12¼,	¾	12¼	11¾
Indo-European	26,	27	27	27
Mediterranean Extension	2¼,	3	—	—
Do. Preference	10,	¼	10¼	10¼
Reuter's	10¾,	11¼	—	—
Submarine	270,	290	280¼	280
West India and Panama	1¼,	¼	1¼	1¼
Do. 1st Preference	6¼,	¼	6¼	6¼
Western Brazilian	8¼,	¼	8¼	8
West. Union 7 per Cent. 1st Mortgage	122,	127	—	—
Do. 6 per Cent. Sterling Bonds	101,	104	103	102

TRAFFIC RECEIPTS FOR FEBRUARY, 1881.

Companies.	Feb., 1881.	Feb., 1880.	Increse.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,900 estd.	3,140	—	240
Direct Spanish Telegraph Company	1,876	—	—	—
Direct United States Telegraph Company	16,390	—	—	—
Eastern Telegraph Company	46,463	44,591	1,872	—
Eastern Extension Telegraph Company	28,021	25,190	2,831	—
Great Northern Telegraph Company	—	—	—	—

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ABSTRACTS OF SPECIFICATIONS.

We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts—ED. *E.*]

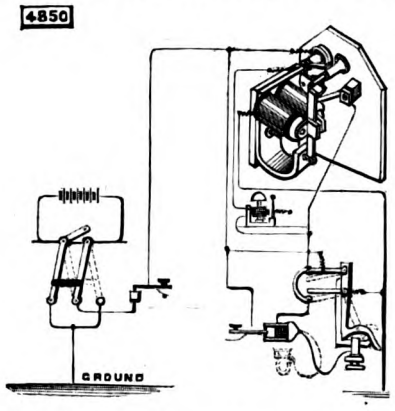
3219. IMPROVED METHOD AND APPARATUS FOR OBVIATING THE EFFECTS OF EXTRANEOUS ELECTRICAL DISTURBANCES ON TELEPHONIC LINES. *J. Imray.—Dated 6th August*, 1880. (*A communication from Dr. C. Herz.*)—*Not proceeded with.*) 2*d.*

Instead of leading the line wire direct to earth from the receiver, the inventor makes it terminate in a number of fine points extended over a large area, another set of points close to the former set communicating by a wire to earth. The space between the sets of points may be filled with alcohol, oil, or other medium.

4850. IMPROVEMENTS IN SWITCHES AND APPARATUS FOR USE UPON TELEPHONE LINES, *S. Pitt.—Dated 23rd November*, 1880.—(*A communication from C. D. Haskins.*) 6*d.*

The object of this invention is to enable signals to be exchanged between a central office and any station without operating the signal or call-bell of any other station on same circuit, and to prevent persons at other stations from interrupting or overhearing a message, and to enable the operator at the central office to set the different instruments at a common starting point. To pre-

4850



vent the bells of other stations in same circuit being operated the inventor uses a shunting and locking instrument, and electrical bell and switch connected together and to the main line; whilst to prevent overhearing he dispenses with the earth wire at sub-stations, and by means of shunting and locking apparatus at each station cuts out every telephone that is not being used. To bring the instruments to a common starting point he makes use of a unison stop; all as shown in the figure.

237,577. TELEPHONE SWITCH, *Homer R. Miller, Framingham, Mass.—Filed September 24th*, 1880.

Brief.—The switching in of any telephone in the line by means of the increased resistance thereby caused locks out all other telephones in the line.

Claim.—(1) In combination with the shunting

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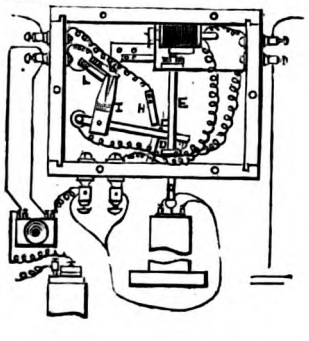

mechanism of a series of telephones in a circuit, locking mechanism, substantially as described, and electro-magnets, said locking mechanism being operated through the magnets by the weakening of the current when any telephone is shunted in, substantially as set forth. (2) In combination with the shunting mechanisms of the series of telephones of a circuit, locking levers and electro-magnets in the main line operating to hold said levers in unlocking position only when no telephone is in the circuit, said locking levers being combined also with mechanism, substantially as described, whereby the unhooking of any one of the telephone receivers prevents the station of that instrument from being locked out, as set forth. (3) The combination, with an electro-magnet situated in the main line of a series of telephones, of a lever and notched rod, E, provided with hook at its lower end and with spring at the upper, said lever being connected to the shunting devices, substantially as described. (4) The combination, with the lever E^1, locking devices, and rod E, of the points D and H and connecting wires, substantially as described. (5) The combination, with the lever E^1, rod E, and locking devices, of insulated prong plate I, points K and L, and battery connections, substantially as described.

237,608. SWITCH FOR ELECTRIC LAMPS, *William Sawyer, New York, N.Y, assignor to Eastern Electric Manufacturing Company, Middletown, Conn.—Filed August 21st*, 1880.

Claim.—(1) In an electric lamp switch, substantially as described, the combination of an insulated plate, to which is secured a series of contact plates, a traversing switch arm enclosed in a fixed metallic case, with a shaft which operates the traversing switch-arm and a metallic cap secured to said shaft, substantially as described. (2) In an electric lamp switch, the combination of an insulated plate, D, having the stop-pin S, and

237.608

the contact plates B B′ B″, with the switch piece A, substantially as described. (3) The combination of the switch piece A, slotted shaft, spring, and recessed case, substantially as described. (4) The combination of the switch piece A, shaft C, secured to said switch piece with a spring, recessed enclosing case, and movable cap secured to the outer end of the cap, substantially as described.

237,632. DYNAMO-ELECTRIC MACHINE. *Wm. E. Sawyer, New York, N.Y., assignor to Electro-Dynamic Light Company, New York.—Filed December 20th*, 1878.

Claim.—(1) A dynamo-electric generating machine constructed of stationary magnets, in which the magnetic force is continuous, such magnets being surrounded with conducting coils, in combination with a rotating barrel of unwound armatures, as distinguished from the stationary magnets, and rotating barrel of armatures of electro-magnetic engines, in which the magnets are energised intermittently to produce motion. (2) The combination of the magnets A S F, connected and operating substantially as described. (3) The two rings H H, connected by magnets and operating substantially as described. (4) The combination of magnets A, rings H, and armature G, operating substantially as de-

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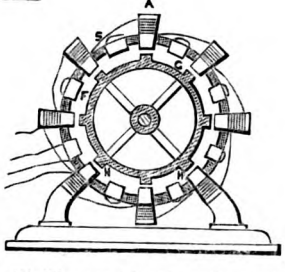

scribed. (5) The combination of a series of contiguous magnets, A, with a series of intervening sections of iron, joining their poles over a rotating armature, substantially as described, for the purpose of inducing and accumulating their magnetic force, substantially as set forth. (6) A dynamo-electric generating machine consisting of united rings fitted with a succession of electro-magnets, and combined with a succession of armatures rotating about a centre common to themselves, and the series of magnets. (7) In a dynamo-electric machine, a succession of electro-magnets fitted and connected upon stationary rims or rings, and energised by a succession of unwound armatures rotating within the rims carrying the magnets.

237,732. ELECTRIC LIGHT, *Thomas A. Edison, Menlo Park, N.J.—Filed June 30th*, 1880.

Claim.—(1) The combination, with the incandescing conductor of an electric lamp, of two fluid columns sustained by atmospheric pressure, and forming both a part of the circuit and the hermetical seal to the lamp, substantially as set forth. (2) The combination, with the incan-

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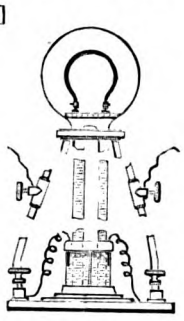

descing conductor and the fluid columns, of reservoirs connected to the source of electricity, and into which the columns dip for the maintenance of the column and the completion of the circuit therethrough, substantially as set forth. (3) The combination, with the electric lamp, of the stand or support therefor, consisting of an insulating base and top connected by adjustable standards, substantially as set forth.

237,753. ELECTRIC TIME REGISTER, *James F. Kettell, Worcester, Mass.—Filed April 3rd*, 1880.

Claim.—(1) The strip of paper or ribbon carried by the drums, one being mounted upon a clock and rotated by its winding arbor, and the other constructed with circumferential pockets and loaded, as described, the strip being arranged to be perforated or marked at a point in its progress between the drums and between the division lines of the strip corresponding to the times registered by a point carried by the armature of an electro-magnet, in the manner and for the purpose set forth. (2) The strip of paper or ribbon carried by the drums, one being mounted upon a clock and rotated by its winding arbor, and the other constructed with circumferential pockets and loaded, as described, the strip being arranged to be perforated or marked at a point in its progress between the drums and between the division lines of the strip corresponding to the times registered by two or more points, each carried by a separate or independent electro-magnet having independent circuits, in the manner set

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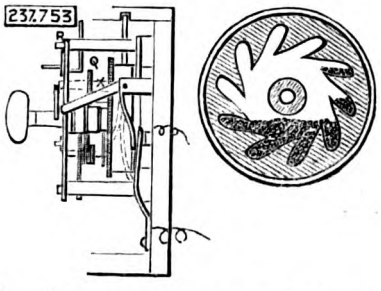

forth. (3) The combination of an electro-magnet and its armature, carrying a puncturing device, with a time movement carrying a strip of paper provided with lines or marks graduated to correspond to the time movement of the clock, as divided into hours or fractions of an hour, or both, the time movement Q, having lever R, lever X, and circuit closer, substantially as and for the purpose specified. (4) The combination of the time movement Q, lever R, lever X, and circuit closer, substantially as set forth. (5) The tension drum, provided with circumferential pockets, and loaded and operating in the manner and for the purpose set forth. (6) In a registering clock carrying a strip of paper or ribbon provided with divisional lines corresponding to the time movement of the clock, the combination of an electro-magnet and its armature, carrying a puncturing device and having its circuit broken at one or more points by a key or keys, which can be operated only at stated intervals of time to close the circuit, substantially as and for the purpose set forth.

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"Freaks of the Telegraph."—An article bearing this title appears in *Blackwood's Magazine* for April.

The Asiatic Cable Bill.—On the 15th March this Bill passed its second reading in the Dominion House of Commons.

Telegraph Communication with the Shetlands.—Communication with the Shetlands is not expected to be established before June.

Eastern Extension Company.—The next ordinary meeting of this company will be held at the Cannon-street Hotel on Wednesday, the 6th April.

SS. "Calabria."—This vessel has been reported as arrived at Cape Town on Saturday, March 26, with head-quarters of 7th Hussars and Royal Artillery, all well.

The City and Guilds Technical College.—Prince Leopold has consented to lay the foundation stone of the City and Guilds of London Technical College in Finsbury.

Fall in Telephone Shares.—The announcement of the new Gower-Bell Telephone Company was accompanied by a fall of 20s. in the shares of the United Telephone Company.

Royal Society.—Last evening Professor Hughes, F.R.S., presented a paper on "Permanent Molecular Torsion of Conducting Wires Produced by the Passage of an Electric Current."

Telegraph Interrupted.—On Friday, the 25th March, a very heavy gale from the north-north-west prevailed at Liverpool, and telegraphic communication with the outports was interrupted.

"Punch" and Telegraph Clerks' Grievances.—Will the telegraph clerks and *employés* be compelled to strike? They have addressed themselves to the Postmaster-General, and said, "Don't *Force it!*"

Discharge of Electricity in Gases and High Vacua. M. F. Narr has made experiments from which it would appear that electricity traverses the gas vacuum. He promises the results at no distant date.

The Society of Arts.—Mr. W. H. Preece read a paper before the members of this society on Wednesday, on "Recent Advances in Electric Lighting." We hope to find room for this lecture in an early number.

The Society of Telegraph Engineers and of Electricians.—At the next meeting of this society, which is fixed for the 14th inst., a paper will be read by Mr. St. George Lane Fox on the subject of "Electric Lighting."

Electric Light in Paris.—M. Daudigny has just petitioned the Municipal Council of Paris for leave to establish an electric light in the Place de la Republique. It will be supplied by a steam engine of 50 horse-power, and diffused by a reflector of his own invention.

Sleepers Awake!—*L'Electricité* says that the Telephone Company in Belgium have inaugurated a very ingenious and at the same time practical system. Subscribers can, by leaving word the previous evening, be awakened at any hour in the morning by means of a powerful alarum.

The Stars and How to Find Them.—For the benefit of our readers abroad we think it desirable to call attention to an article in *Good Words* for April, entitled "The Stars and How to Find Them," which will enable them by an easy method to find the position of the principal stars.

Prices.—The prices as quoted are:—For gutta percha, per lb., genuine 4d. to 3s. 3d., reboiled 3d. to 1s. 3d., and for india rubber, per lb., Para, fine 3s. 7d., negrohead 2s. 5d., Central American 1s. 10d. to 2s. 4d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d.

Receipts.—The traffic receipts of the Brazilian Submarine Telegraph Company (Limited) for the week ended March 25 amounted to £3,688; and those of the Western and Brazilian Telegraph Company (Limited) to £2,521, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

Bleaching Albumen by the Electric Light.—The albumen (says M. Manet), from which the blood corpuscles have been entirely removed, is subjected to the action of an electric light, the rays of which are properly collected by means of lenses, &c., and will be bleached within twenty-four hours. The albumen may be in a dry or fluid state.—*Moniteur Prod. Chim.*

Lord Dunraven.—His lordship, in a letter to the *Standard*, contradicts a statement made by that paper to the effect that he is about to become a director of the "European, American, and Asiatic Submarine Telegraph Company." He says he has no intention of joining the board, and was ignorant of the existence of the company until the appearance of the paragraph in the *Standard*.

The Canada Cable Company.—We hear that the Canadian Senate has amended the Act to incorporate the European, American, and Canadian Cable Company (Limited) so as to restrict the rate to be charged to fifty cents per word on every message sent over the Company's lines from the point where the message is received in Canada as far west as Ontario to any point in Great Britain and Ireland, or *vice versâ*.

Volunteer Engineer Telegraphists.—The Newcastle wing of the 1st Newcastle and Durham Engineer Volunteers underwent a practical test the other day. Amongst other things thirty lines of a newspaper column, equal to 240 words, were flashed across the Tyne by means of lamp signals, and read off in thirty minutes. The lamps were the same as used in the army, and this rate is said to be above the average of the regulars

The Gower-Bell Telephone Company.—A company with this title is announced, with a capital of £600,000, in shares of £1, 300,000 of which form the first issue. According to the prospectus the company has some heavy contracts in hand, which promise to realise large profits. It may be noticed that the Government has adopted the Gower-Bell form of instrument, and that large orders on this account have been executed and more are expected.

Swan's Light in Coal Mines.—The Swan electric light is, we learn, to be "laid on" to Mr. John Watson's Earnock Colliery, Motherwell, and will extend to the pit bottom, the roadways, the station where the underground engine is placed, and possibly the miners' working places. Mr. Watson is of opinion that the lighting of a coal pit by electricity is both feasible and practicable, and he has determined to put his opinion to the test. The result will be looked forward to with the keenest interest by all connected with the coal mining industry.

Professor Helmholtz.—The event in connection with this distinguished foreign professor's visit to London, to which the President of the Society of Telegraph Engineers referred at its last meeting, is likely to take the form of a reception or *soirée*. Rooms more spacious than those belonging to the society itself will, it is believed, be placed at the service of the Council for this occasion by one of the learned corporate bodies of the metropolis; and, subject to

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Professor Helmholtz's final answer, the date is fixed for Monday, the 11th inst.

Brooks's System of Insulation.—We hear that Mr. Brooks's system has been tried with great success between Waterloo and Nine Elms Station on the London and South Western Railway, with 30 wires in a tube, for one year. Encouraged by this success, the Government is about to extend the system from Nine Elms to Queen's-road Station with 30 wires in a tube, and from Queen's-road to Clapham with 40 wires in a tube. Mr. Goldstone, of the London and South Western Railway, is doing the work for the Silvertown Works, who are the contractors.

Swan's Light at Manchester.—There are 28 of Swan's lamps now in use at the offices of the Lancashire and Yorkshire Railway, at Hunt's Bank, Manchester. The generating power is an "A" Gramme generator, and is equal to the production of $1\frac{1}{2}$ Brockie lamps. The wires are attached in the ordinary way, and fixed along either side of the interior of the building, the lamps being arranged in multiple arc, two in a series. The directors of the company have viewed the experiments carried on at the station, and have expressed themselves as being highly pleased with the result.

Electrical Conductivity of Saline Solutions.—In the *Journal of the Chemical Society* for March is an abstract of a paper by J. H. Long in the *Ann. Phys. Chem.*, in which the author describes his continuation of the investigations of Kohlraush on the conductivity of saline solutions at different temperatures and states of concentration. The salts examined were the chlorides of manganese and zinc, and the nitrates of copper, strontium, and lead. The results, of which tables and graphic representations are given, are discussed in relatio to the observations of other experimenters.

Selenium as a Regulator for Painted-glass Furnaces.—The uses of selenium are multiplying. M. R. Germain describes, in the *Comptes Rendus*, one of its latest applications, which is as follows:—The muffle in which the glass is heated is provided with a window of very refractive alumina glass, so that the red glow within the furnace may reach a distant mirror. This latter concentrates the rays on a sphere of selenium, and the modification in the electric conductivity of that substance thus induced acts on a mechanical arrangement whereby the fire bars are withdrawn, and the fuel allowed to fall out as soon as the right temperature for fusing the enamels has been reached.

Queensland Telegraphs.—According to the latest statistics it would appear that the number of telegraph stations in 1879 was 161, against 43 in 1870; the number of miles of telegraph line was $5,870\frac{3}{4}$, against 2,132; and the miles of wire $7,891\frac{3}{4}$, against $2,221\frac{1}{4}$ for the same years. The number of messages transmitted was 514,292 in 1879, against 81,483 in 1870, whilst the number received into Queensland for the same years was respectively 48,963 and 7,885. The messages transmitted show a rapid increase in 1873 and 1874, but the annual increase decreases year by year after that, as the following figures show (000's omitted, thus + 34 = + 34,000, and so on for the rest):—1873, + 34; 1874, + 155; 1875, + 98; 1876, + 70; 1877, + 33; 1878, + 26; 1879, − 24.

Electric Lighting on the Embankment.—In a recent report of the Works and General Purposes Committee of the Metropolitan Board of Works it was stated that they had received a letter from the Société Générale d'Electricité, requesting the board to extend the time for lighting the Victoria Embankment by the electric light to the 30th June next. The present contract, which was for a period of one year, would expire on the 10th April next; but the committee were informed that the lighting did not actually commence, owing to the necessary preparations, until three months later. They saw no objection to the extension of time as proposed, and they recommended that the application be granted, subject to the terms of an agreement to be prepared by the board's solicitor. The recommendation of the committee was approved.

To Our Friends Abroad.—The enlargement of this journal, which commences with the present number, seems a suitable occasion for again inviting our readers at foreign stations to favour us with any pieces of intelligence that may be of interest to readers stationed elsewhere. *The Electrician* circulates in every quarter of the globe, and we desire not only to publish the best home news relating to the progress of electrical science but also such general news as may have a special interest for cable companies' clerks wherever they may be situated. From gentlemen in charge of technical departments we shall always be glad to receive contributions. The opportunities for observation of electrical phenomena at foreign stations are quite exceptional, and the results would often be esteemed of great value here. No more suitable medium for publicity exists in this country than the pages of *The Electrician*.

New South Wales Telegraphs.—The number of telegraph stations in the colony at the end of the year 1879 was 273. Telegrams forwarded from these stations during the year numbered 1,175,218, for which the sum of £103,033 was received. The total number of miles of wire constructed was 12,426, the cost of which was £437,120 5s. Ten years previous, viz., in 1870, the figures were as follow:—Number of stations, 86; telegrams forwarded, 173,812; amount received for such telegrams, £28,550; number of miles of wire constructed, 5,247; cost of construction £195,544 15s. Amongst the names of the stations are one or two which may be compared to the German adjectives which are immortalised by Mark Twain. Here they are:—Coonabarabran, Ginninderra, Jerilderie, Kynnumboon, Murrumburrah, Murrurundi, Ulladulla, Wallerawang. These must be pleasant for receivers of messages.

Thermic Theory of Electricity.—When any disturbance of the motions of molecules occasions a loss of their *vis viva* an equivalent quantity of electricity appears. The division of bodies into classes, according as their conductivity is distinguished as metallic or electrolytic, is artificial. A current arises when at least one of the substances in a closed circuit has its conductivity increased by rise of temperature. The electricity of friction and pressure arises from the contact of heterogeneous substances, by which the loss of molecular *vis viva* is occasioned. Friction simply increases the intimacy of the contact by multiplying the points at which the bodies touch, and it unequally raises the temperature of both substances, thus producing conditions which co-operate in augmenting the effect. The electricity of friction and pressure has the same origin as that of the pile.—J. L. Hoorweg, in *Annales Phys. Chem.*

Overhead v. Underground Wires.—A novel argument in favour of underground wires has arisen at Hull. It appears that a gentleman of the name of George Lamb had a telephone in his house, the wire of which crossed his neighbour's garden, that neighbour being of the gentler (?) sex. Now, it appears also that, although Mr. Lamb had obtained permission of the Corporation of Hull to erect the telephone wire, he had omitted to request the permission of this particular lady. Well would it have been for him had

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he done so. The consequence of this omission on his part was that one day he found himself, with a telephone certainly, but with one that would not work. Further inquiry showed that the lady, with a promptitude worthy of a better cause, had severed the wire. We would beg all owners of a telephone to be careful to get into the good graces of their fair next door neighbours, if they would not meet the fate of Mr. Lamb.

Mr. Fawcett and the Telegraph Clerks.—The Postmaster-General has taken the unusual course of addressing a strong remonstrance to the telegraphists against the line of action they seem disposed to take under the influence of their delegates, and which, while it can in no degree further the object of their memorial, calls for the expression of his strong disapprobation. Mr. Fawcett complains that the proceedings at the interview between himself, the delegates, and the principal officers of the department, have been misrepresented, whilst accusations of "unfairness," "injustice," and "breach of faith" are being publicly made at the very time he is taking every pains to form a correct judgment upon the alleged grievances. He will not, however, allow this conduct to prevent him doing full justice to the case of the telegraphists generally; but adds that the questions submitted to him are so numerous, and involve so many complicated considerations that some time must necessarily elapse before a final decision can be arrived at.

International Electrical Exhibition.—We are enabled now to give the classes into which the several groups of exhibits are proposed to be divided. Group I.: Production of electricity. Class 1, static electricity; class 2, batteries and accessories; class 3, magneto-electric and dynamo-electric machines. Group II.: Transmission of electricity. Class 4, cables, wires, and accessories, lightning conductors. Group III.: Electrometry. Class 5, apparatus for measuring electricity. Group IV.: Applications of electricity. Class 6, telegraphy. Signals: Class 7, telephony, microphony, photophony. Class 8, electric lighting; class 9, electric motors, transmission of force; class 10, medical electricity; class 11, electrochemistry; class 12, instruments of precision, electro-magnets, and magnets, compasses, electric clocks; class 13, various apparatus. Group V.: General mechanics. Class 14, generators, steam, gas, and hydraulic engines, and power transmitters in relation to electrical industries. Group VI.: Bibliography, history. Class 15, collections of works referring to electrical science and industry, &c. Class 16, retrospective collections of apparatus referring to the first study and oldest applications of electricity.

Effect of Strain on Electric Conductivity.—This was the subject of a paper, by Mr. Witkowski, recently communicated to the Royal Society of Edinburgh by Sir W. Thomson. An electric current is made to traverse a cylindrical brass tube, with a magnet, to which is attached a mirror, suspended horizontally in the centre at right angles to the axis. When the cylinder is in its original isotropic condition the magnet is unaffected by the current. If a couple be applied in a plane at right angles to the axis, so as to distort the tube, and render it ælotropic with regard to its conductivity, the current being given a spiral set, the suspended magnet is deflected. The lines of flow are found to set spirally round in a contrary direction to that of the couple, which is quite in accordance with the theory of twists, which requires a lengthening, and so an increase of resistance, along spiral lines that set round with the couple, and a simultaneous compression, and corresponding decrease of resistance, along lines at right angles to these. Quantitative results are obtained by balancing the electro-magnetic action of the current in the strained tube by means of an external circular movable conductor traversed by a steady current.

Dielectric Capacity of Liquids.—Under this title a paper was communicated to the Royal Society by Dr. J. Hopkinson, F.R.S., in January last, of which the following is an abstract:—These experiments have for object the determination of the refractive indices, and the specific inductive capacity of certain liquids, and a comparison of the square of the refractive index for long waves and the specific inductive capacity. In the following table are given the results obtained for refractive index for long waves, deduced by the formula $\mu = \mu_\infty + \frac{b}{\lambda^2}$, the square of μ_∞, and the observed values (κ) of the specific inductive capacity:—

	μ^2_∞		κ
Petroleum spirit (Field's)	1·922	.....	1·92
Petroleum oil (Field's)	2·075	.....	2·07
Petroleum (common)	2·078	.....	2·10
Ozokerit lubricating oil (Field's)	2·086	.....	2·13
Turpentine (commercial)	2·128	.....	2·23
Castor oil	2·153	.....	4·78
Sperm oil	2·135	.....	3·02
Olive oil	2·131	.....	3·16
Neatsfoot oil	2·125	.....	3·07

It will be seen that while for hydrocarbons $\mu^2_\infty = \kappa$, for animal and vegetable oils it is not so.

What Next?—The *Globe* of Friday last is responsible for the following:—"It would be very curious if by-and-by the various discussions and experiments with respect to the lighting of the interiors of houses and public buildings should result in the total banishment of all kinds of lamps—oil, gas, electric, or any other kind—from such interiors. That, however, is the possibility very clearly indicated by a proposal of the American Northern Electric Light Company. They want to be allowed to illuminate the Capitol at Washington, not by carrying their system into the building at all, but by simply banishing darkness from the vicinity of it. Over the Capitol, and at various points in the grounds attached to it, they propose to set up such a blaze of light as will fill the air with a sort of artificial broad daylight, which would, of course, find its way into the skylights and windows of the Capitol just as real daylight does. They would have altogether 450 lamps of about 6,000 candle-power each, the whole affording the light of 200,000 ordinary gas burners, and as many of them would be some fifty feet above the roofs of the building, it is estimated that they would shed light enough over the city of Washington to obviate the necessity of street lamps. Of course the projectors of this scheme demonstrate in the most complete manner that it would be vastly cheaper than the present system of illumination, but Congress does not appear to be particularly captivated by the notion, and declines to have anything to do with it. This is a great pity, because the experiment would certainly have been most interesting, whatever the economical issue might have been."

New Telephones of Herren Sasserath and Lehman.—Herr Sasserath replaces the metallic membrane by a plate of mica or other non-conducting material, which rests in its centre on an india rubber cube, behind which is placed a horseshoe magnet. One of the poles of the magnet is prolonged in the interior in a kind of vibrating plate, to which the india rubber cube communicates the vibrations of the membrane. The other pole is surrounded by a coil of conducting wire, and the core of this coil is prolonged nearly to the metallic plate, so that both poles are in the centre of the magnetic field. When the instrument is spoken into the mica plate vibrates; these vibrations are transmitted to the

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metal plate, and produce variations in the magnetism which give rise to induced currents in the coil. These, acting in inverse manner in the receiver, put in motion first the metal plate, then the mica plate, and reproduce the words. A distributing screw and spring allow of the regulation of the pressure of the india rubber on the mica and the flexible plate, as also the distance of the magnet from the membrane. Herr Lehman's telephone is on a different plan to the above, and is based on the fact that a powder formed of a mixture of carbon and a metal is a bad conductor when loose, but is, on the contrary, a good conductor when compressed. It is, in reality, a microphonic transmitter similar to M. Righi's. The iron membrane carries at its centre a polished steel needle, very conical in shape. Close to the membrane is a small envelope of india rubber containing a powder formed of 25 per cent. of silver, and 75 per cent. of carbon. This elastic envelope is enclosed in a small brass box, which allows it a certain amount of play, and to the bottom of which is attached a distributing screw in direct connection with the powder by an opening in the lower part of the india rubber envelope. On the other side the needle also is in connection with the powder. The apparatus is placed in circuit with a battery and a telephonic receiver, one of the wires being connected with the distributing screw, the other with the vibrating plate. The vibrations given to the membrane by the voice, give forward and backward motions to the needle, which vary its pressure on the powder, and modifies the conductivity so as to reproduce speech in the receiver.—*Electrotechnische Zeit.*

New Telephone Transmitter.—In the *Scientific American* for March 19 Mr. G. M. Hopkins describes a new telephone transmitter, in which everything except the battery, bell, and receiver is contained in a box. In the centre of the cover is the mouthpiece, behind which is placed the diaphragm, consisting of ordinary Russia iron of the thickness commonly used in stove-pipes. It is $2\frac{3}{4}$ inches in diameter, and is held in position in a circular cast-iron frame by two springs attached to the frame and pressing the diaphragm. The edge of the diaphragm is bound with soft rubber or felt. This arrangement, however, is not essential to the successful working of the instrument, as equally good results may be obtained when the diaphragm is clamped tightly at the edges between two rings fastened with screws to the front of the box. To the centre of the diaphragm is attached a metal clamp, which supports in a horizontal position a cylindrical pencil of hard electric-light carbon, $\frac{1}{4}$ inch in diameter and 1 inch long. A disc of battery carbon $1\frac{1}{4}$ inch in diameter and $\frac{1}{4}$ inch thick, is grooved around the edge and wound with fine copper wire, which terminates in a flexible spiral connected with the upper hinge of the box. The carbon disc is suspended by a silk thread from a spool formed on the inner end of a screw, extending through the box cover, and capable of being turned so as to raise or lower the carbon disc as may be required. The disc is slightly inclined from the perpendicular, and the line of contact between it and the carbon pencil is a little above the centre of gravity of the disc. This arrangement of the two carbons prevents any marked break in the local circuit, as the disc tends to rock on the carbon pencil rather than fly from it when the diaphragm is set in vibration. The carbon disc has been saturated with melted paraffin, in some instances with beneficial results. The clamp which holds the carbon pencil is electrically connected with the lower hinge of the box. The receiver has a diaphragm of the usual size mounted in a hard rubber case $2\frac{1}{8}$ inches in internal diameter and one inch deep. A bobbin of the usual style is placed on a soft iron core having a large convex head, and held in place by a screw extending through the bottom of the case. A soft rubber bottom is placed between the casing and the convex end of the core, and eight curved permanent magnets, $\frac{1}{8}$ inch thick and $\frac{1}{4}$ inch wide, touch the convex end of the bobbin core, and are pressed upward into contact with the diaphragm by a rubber ring at the bottom of the case. The diaphragm at its points of contact with the magnets is freed from japan or oxide, and the ends of the magnets are let into notches cut in the case, so that when they press upon the diaphragm the latter is backed by the mouthpiece.

Cantor Lectures.—In our last issue we should have stated that Hjorth was the inventor who, in 1854, discovered the method of increasing the power of a dynamo machine by placing the armature and the coil of the field magnet in the same circuit. The subject of the fourth lecture by Professor W. G. Adams, F.R.S., was "The Sub-division of the Electric Current and Lighting by Incandescence." The lecturer showed that objections raised to the electric light were similar to those which had been urged with regard to gas when it was first introduced. He then compared the energy of Grove's cells with the energy derived from a small Gramme machine, and showed how impracticable it was to attempt to do by means of batteries the work which can be done by such machines. He then explained how the same amount of energy might be spent in two classes of machines, those of low internal resistance and low electromotive force, which send a strong current through small external resistance, or quantity machines, and those of high internal resistance and high electromotive force sending a smaller current through large external resistance, or tension machines. For very high resistances the discharge of an induction coil is taken, the action of which was compared to the action of the hydraulic ram. Professor Adams proceeded to describe the Werdermann and the Joel lamps, which we drew attention to in our last issue, and explained the kind of machine specially suited for such lamps, and regretted that it would not be possible to show them to the best advantage or to give them a fair trial, because the machine actually in use at the speed at which it was running was not adapted for them. An electromotive force of 130 volts will send 50 webers through ten lamps in series and give an illumination of 320 candles in each lamp for an expenditure of 4 or 5 h.-p. Taking Mr. A. Siemens's facts as to the cost, it appears that the electric light from the Joel lamp would be as cheap as gas at the rate of 2s. per 1,000 cubic feet. The laws of the sub-division of the electric current were discussed, and their application to the system of incandescent lighting adopted by Swan and by Lane Fox and Edison was clearly shown. With the Bürgin machine then in use, giving, at 1,620 revolutions a minute, an electromotive force of 160 volts, and a current of 24 webers through an external resistance of about 7 ohms, it was shown that twenty-four rows of two Swan lamps in series, or forty-eight lamps, could be lit up, each lamp being of 80 ohms resistance, and giving a 48 candle-power light. If the resistance of each lamp be 40 instead of 80 ohms, then double the number of lamps might be taken in series, giving about 100 lamps from the machine. With the Brush machine at least 140 lamps might be lit up in ten parallel rows of fourteen lamps in series. The early attempts of King and Staite and Koun to light by incandescence were then explained, and experiments made to illustrate the phenomena seen in high vacua, such as are necessary to enable Mr. Swan and Mr. Lane Fox to preserve their carbons from wasting when rendered incandescent by means of the electric current.

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THE EVOLUTION OF DYNAMO AND MAGNETO ELECTRIC MACHINES.—I.

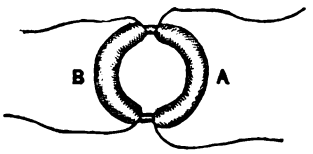
By γ. β.

Romagnesi in 1802 observed the action of a passing current upon a magnetic needle. A description of his experiments was given in a work, entitled "Essai Théorique et Expérimental sur le Galvanisme," by Giovanni Aldini, dedicated to Bonaparte, and printed in 1804; also, in the "Manuel du Galvanisme,' by I. Izarn, published in Paris in 1805. The latter book seems to reproduce the sentence in the former, which is to the effect that M. Romagnesi, of Trente, has observed that galvanism causes a deflection of the magnetic needle.

The effect, however, was far more clearly established by Œrsted, who observed the phenomenon in 1819, and published his researches in 1820.

The converse discovery, showing the effect of a magnet upon a conductor, was made in 1831 by Faraday. The first paper in Vol. I. of his "Experimental Researches in Electricity" is divided into four sections, dealing respectively with "The Induction of Electric Currents," "The Evolution of Electricity from Magnetism," "A New Electrical Condition of Matter," and "Arago's Magnetic Phenomena." This paper was read before the Royal Society on Nov. 24, 1831, and in order to proceed historically with the question before us it will be necessary to reproduce a portion of this paper. The second division is that which interests us most. It treats, as we have said, of the "Evolution of Electricity from Magnetism." Faraday took a welded ring of soft round bar iron ·875in. thick, the complete ring being 6in. in external diameter. Three helices of insulated copper wire (A Fig. 1) were put round one part of the ring. Each helix con-

FIG. 1.



tained about 24ft. of wire, of ·05in. diameter. The helices were superposed, but insulated from the iron and from each other, and could be used separately or together. On the other part of the ring (B Fig. 1), 60ft. of similar wire in two helices were applied, having the same common direction as the helices A. About ·5in. of the ring remained uncovered, as seen in the figure. On the helix B being connected with a galvanometer, and the helices A joined to form one helix being connected with a battery, a deflection of the needle occurred on making and breaking the battery contact, the deflection on breaking contact being in the opposite direction to that on making contact. Upon arranging the apparatus so that B should be out of use, the galvanometer in circuit with one of the A coils, while the other two A coils were in the battery circuit, a similar action of the needle was observed in making and breaking the battery contact. No making or breaking of the contact on the B side, or in any part of the galvanometer circuit, produced any effect at the galvanometer. No continuance of the battery current caused any deflection of the galvanometer needle. Many experiments are recorded with coils on coils, without an iron core, and with an iron core.

"Similar effects were then produced by *ordinary magnets*."

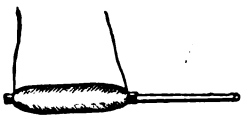
This sentence is perhaps the most important in the annals of the literature of electricity. It is the starting point of the epoch of the construction of machines for the production of an electric current. By machines here we intend merely to indicate magneto and dynamo electric machines.

Faraday used a combination of helices upon a hollow pasteboard cylinder. There were eight lengths of copper wire, containing altogether 220ft. The helices could be connected four

FIG. 2.

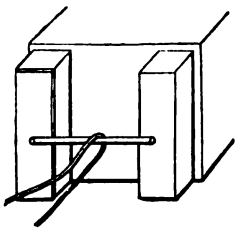
and four, or otherwise, as required. They were for this experiment all connected, and so formed one coil which was connected with the galvanometer by two copper wires, each five feet in length. A soft iron cylinder was introduced into the axis of the coil. Two bar magnets, each twenty-four inches long, were arranged with their opposite poles at one end in contact, so as to represent a horse shoe magnet, and then contact was made between the other poles and the ends of the iron cylinder (Fig. 2), so as to convert it for a time into a magnet. Upon making magnetic contact the needle was deflected. Continuing the contact, the needle became indifferent and resumed its first position; on breaking contact it was again deflected, but in the opposite direction to the first effect, and then it again became indifferent. When the magnetic contacts were reversed, the deflections were reversed. Afterwards, a magnet

FIG. 3.



was suddenly thrust into the coil, instead of acting upon the iron core, and opposite deflections obtained on its insertion and withdrawal. The experiments were continued with the use of a large compound magnet, the effects being similar to those described, though much greater. Then the helices were dismissed, and the galvanometer wire passed over the iron cylinder (Fig. 4).

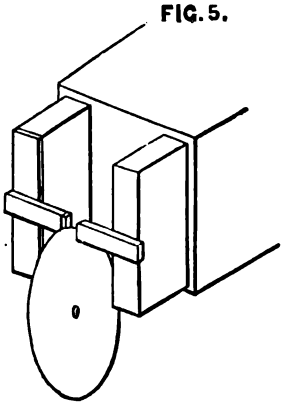
FIG. 4.



Again, as the helix, with its iron core, was brought towards the magnetic poles, but *without making contact*, powerful effects were produced. From the helix without the core when approached or withdrawn the effects were obtained. Single wires, approximated in certain directions towards the magnetic pole, had currents induced in them. On their removal the currents were inverted.

Upon obtaining electricity from magnets by the means described Faraday did not despair "of being able to construct a new electrical machine." He demonstrates "the production of a permanent current of electricity by ordinary magnets" by the following experiment. The apparatus is shown in Fig. 5. The

FIG. 5.



poles of the magnet were crossed by the iron or steel bars as shown, which could be adjusted as required. A disc of copper fixed on an axis was mounted to allow of revolution vertically or horizontally, its edge being at the same time introduced more or less between the magnetic poles. The edge of the plate was amalgamated, and brushes of copper or lead were used to make

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contact with the disc. The copper disc was arranged as shown the small magnetic poles being about ½in. apart, and the edges of of the plate inserted, about half their width between them. One galvanometer wire was passed twice or thrice loosely round the brass axis of the plate, the other being attached to the conducting brush held in contact with the edge of the disc at the part immediately between the magnetic poles. So long as the plate was at rest the needle remained quiescent, but on rotating the plate the needle was largely deflected. A number of experiments led to the conclusion that the "rotating plate is merely another form of the simpler experiment of passing a piece of metal between the poles in a rectilinear direction, and that in such cases currents of electricity are produced at right angles to the direction of the motion, and crossing it at the place of the magnetic pole or poles." A mere wire connected with the galvanometer, so as to form a complete circuit, when passed between the poles, caused deflections. This remarkable paper of Faraday's, after describing many experiments, after speaking of the drawing off of currents from the copper plate, "which can pass through narrow wires forty, fifty, sixty, or even one hundred feet long," details "two rough trials made with the intention of constructing *magneto-electric machines*."

In one, a ring of one inch and a half broad and twelve inches external diameter, cut from a thick copper plate, was mounted so as to revolve between the poles of the magnet. The inner and outer edges were amalgamated, and the conductors applied one to each edge, at the place of the magnetic poles. The current of electricity evolved did not appear by the galvanometer to be stronger, if so strong, as that from the circular plate.

In the other, small thick discs of copper or other metal, half an inch in diameter, were revolved rapidly near the poles, but with the axis of rotation out of the polar axis, the electricity evolved being collected as before by conductors applied to the edges. Currents were produced, but of strength much inferior to that produced by the circular plate.

We may, we think, safely look upon the circular plate machine shown above as the first magneto-electric machine made.

THE PHYSICAL SOCIETY.—March 26, 1881.

Professor Fuller in the chair. New member: Mr. Lewis Wright.

Electrostatic Induction.

Dr. James Moser read a paper on "Electrostatic Induction," especially relating to the branching of induction in the differential inductometer and in the electrophorus. These experiments tended to confirm Faraday's hypothesis of induction. Professor Ayrton suggested the importance of adding guard rings to the small plates of the fine plate induction balance, since without these mathematical calculation could not be accurately applied, and experimental determination of inductive capacities by this apparatus would be doubtful. The fact that the plates were not infinitely large in area as compared with their distance rendered the method faulty in theory. Dr. Moser admitted the truth of this, but showed that it was possible for the experimenter to make it very approximately accurate in practice.

The Electrical Resistance of Liquid Films.

Professor Reinold, of the Royal Naval College, Greenwich, read a paper by himself and Professor Rückert on "the Electrical Resistance of Liquid Films," with a revision of Newton's scale of colours.

The experiments were a continuation of those published by the authors in 1877. The object of them was to determine whether a liquid film, such as the wall of a soap bubble, in thinning under the action of gravity, gave any evidence by a change in its specific resistance of an approach to a thickness equal to twice the radius of molecular attraction, and also to devise a method of finding the amount of water which might be absorbed by or evaporated from it.

The thickness of the film was determined from its colour. This necessitated a revision of Newton's table of colours, which was carried out partly by observations on Newton's rings, made by pressing a convex lens on a plane of glass, and partly by more than two thousand observations on the films themselves. Two simultaneous but independent measures of the thickness of the film were made by throwing two separate beams of light from two mirrors to the surface of the film, where they made two bright parallel bands. The colours of these bands were noted by a telescope, and the thickness of the film was determined from these colours by direct observation on Newton's rings. Each colour in Newton's table was divided into ten parts, or tenths of a tint, and by the corrected tables the error of thickness was never more than 1 per cent., whereas by the old table it sometimes amounted to 10 per cent.

The films were formed in a glass case, in which they could be made without admitting any external air into the interior. The solution employed was made by dissolving oleate of soda, 1 part by weight, in glycerine, 30 parts by volume, and adding a little nitrate of potash to increase the conductivity. A bubble was created by dipping a cylindrical ring into the solution, and blowing up an india rubber pipe communicating with the back of the ring. The swollen bubble then caught in a ring placed opposite to the other, and by sucking out a little of the air again the bubble could be made to take the shape of a transparent cylinder joining the two rings as with a wall.

Elaborate precautions were taken to maintain the aqueous vapour within the case at the tension proper for contact with the solution, in order to prevent evaporation of the film or absorption of moisture by it. These consisted in placing discs containing the solution at the bottom of the case, and suspending within it sheets of blotting paper, the lower edges of which slipped into the liquid. A hair hygrometer indicated changes in the hygrometric condition of the space.

The resistance of the films was measured by piercing them with probes or electrodes of gold wire, which were connected to the electrodes of a Thomson quadrant electrometer by means of mercury cups. The resistance of the film between the needles was calculated by comparing the deflection caused by the difference of potential of the two wires when a current was passing through the film with that produced by the difference of potential above and below a known resistance placed in the same circuit.

The specific resistance of the liquid from which the films were formed was measured by a method identical in principle with the above. The liquid was contained in a horizontal glass tube, with turned up ends. Platinum wires were cemented into small holes drilled in the straight part of the tube, and the current was sent through the liquid from two flat spirals of platinum wire dipped into it at the turned-up ends of the tube. The difference of potential between the platinum wires cemented into the horizontal portion of the tube was compared by means of a Thomson quadrant electrometer with the difference of potential between two points in the same circuit, separated by a known resistance. This method has the great advantage of getting rid of any difficulties connected with polarisation. Nevertheless there is a certain disturbing element which enters even here. The platinum points cemented into the tube were found to acquire differences of potential, sometimes in one sense and sometimes in the other, irrespective of the direction of the current in the liquid, and therefore due not to polarisation, evidently, but to some other cause, perhaps oxidation of the metals. This phenomenon led to the selection of gold for the film probes, because, though it appears with gold, it is less marked. Every precaution was taken to eliminate this effect, either in the apparatus or by subtracting it from the observed effect.

With the view of ascertaining how far the results furnished by this method agreed with those obtained by other observers, test experiments were made on solutions of sulphuric acid. The results agreed with those of Kohlrausch (who employed alternating induction currents and a Wheatstone Bridge arrangement) to within 0·7 per cent.

The results of the experiments may be briefly summed up as follow:—

1st. It is difficult to form a soap film under conditions such as to preclude a slight evaporation or absorption of water.

2nd. The films observed under the most favourable conditions obeyed Ohm's law with great accuracy, and better than films observed under less favourable conditions.

3rd. The films afford no indication of an approach to a thickness equal to the diameter of molecular attraction.

4th. A soap film may even in an enclosed space readily lose 23 out of the 57·7 volumes of water contained in every 100 volumes of the solution, when special precautions are not taken to maintain the surrounding space in a constant hygrometric condition.

In the discussion which followed the reading of the paper Professor Ayrton suggested that the varying potentials of the platinum electrodes in contact with the liquid might be due to unequal amounts of gas absorbed by the platinum. He also pointed out the importance of varying the distance between the platinum wires while using the same current, and measuring the resistance corresponding to these distances.

Professor Guthrie pointed out that the results of Kohlrausch and Professors Reinold and Rückert agree with those of himself and Mr. C. V. Boys, obtained by induction currents circulating through liquids, in proving that the electric resistance of liquids obeyed Ohm's law.

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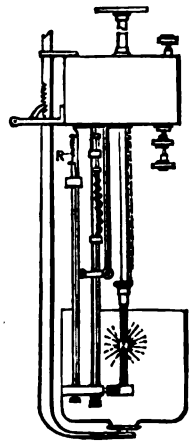
ABSTRACTS OF SPECIFICATIONS.

4866. IMPROVEMENTS IN ELECTRIC LIGHTING APPARATUS, *W. R. Lake.—Dated 23rd November*, 1880.—*(A communication from H. S. Maxim.)* 6*d*.

This is an arc lamp, the details of which are shown by the drawings. The action of the car-

4866



bons is regulated by an electro-magnet, which, with a varying current, attracts its core more or

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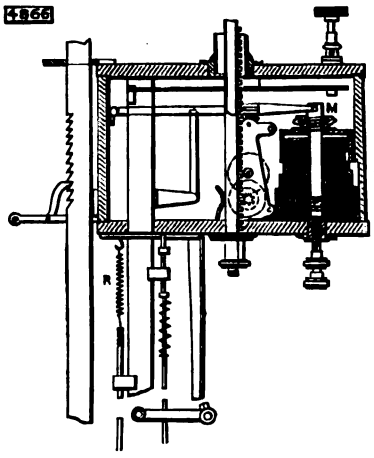

less, and acts on both carbons. The length of arc is regulated by the tension of spring R.

5092. IMPROVEMENTS IN MAGNETO-ELECTRIC SPEAKING TELEPHONY, *H. J. Haddan.—Dated 7th December*, 1880.—*(A communication from S. and M. Barlow.)* 4*d*.

The invention consists simply of the arrange-

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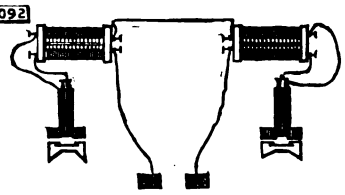
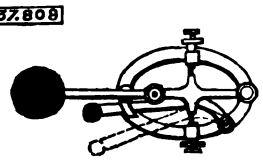


ment of telephones and induction coils in circuit as shown in the figure.

237,808. TELEGRAPHIC KEY, *Jesse H. Bunnel, New York, N.Y.—Filed October 15th*, 1880.

Claim.—A telegraphic key lever constructed from a single piece of wrought metal in the form of a cross, of a breadth greater than its depth or

237,808

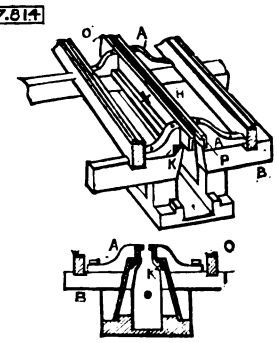


vertical thickness, and provided with trunnions formed upon the extremities of the transverse arms of the cross.

237,814. CONSTRUCTION OF CABLE RAILROADS, *Henry Cagebolt, San Francisco, Cal.—Filed December 11th*, 1880.

Brief.—The ties supporting the slot rails do so through the medium of adjustable brackets. Uses, the commercial flat rail for the slot rails. *Claim.*—(1) In a cable wireway, the adjustable brackets A, adapted to sustain the slot rails attached to and in combination with the ties B, for the purpose set forth. (2) In combination with a tunnel

237,814

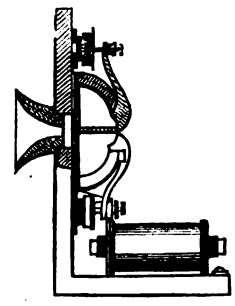


adapted to contain a cable for an endless wireway, the slot rails H having a heavy rib, O, and a depending web, P, substantially as described for the purpose set forth. (3) The bracket A, provided wth lugs, K, in combination with the angle-iron stringer X, substantially as and for the purpose described.

237,856. TRANSMITTER FOR SPEAKING TELEPHONES, *Webster Gillet, Brooklyn, N.Y.—Filed November 4th*, 1880.

Claim.—(1) Combination of two or more induction coils having their primary wires included in independent local circuits, a variable resistance in each of said local circuits, and a single diaphragm or vibrating plate which acts to vary the said resistances in each local circuit simultaneously and proportionately. (2) The combination, substantially as hereinbefore set forth, of two or more induction coils having their primary wires included in independent local circuits and their secondary wires respectively included in a main circuit common to both, a variable resistance in

237,856

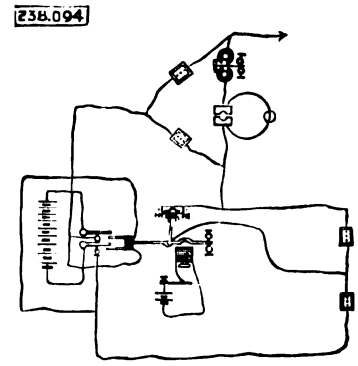


each of said local circuits, and a single diaphragm or vibrating plate which acts to vary the said resistances in each local circuit simultaneously and proportionately. (3) The combination, substantially as hereinbefore set forth, of two or more induction coils having their secondary wires included in parallel branches of a main circuit and their primary wires included in independent local circuits, and a single diaphragm or vibrating plate which acts to vary the said resistances in each local circuit simultaneously and proportionately.

238,094. DUPLEX TELEGRAPH, *George D'Infreville, New York, N.Y.—Filed December 6th*, 1880.

Brief.—The capacities of the main and artificial lines are made equal at the instant of transmitting a signal by automatically diminishing the resistance in the latter for an instant only, and then restoring it to its normal condition. *Claim.*—(1) The method, substantially as hereinbefore set forth, of counterbalancing the effects of the current of charge in a duplex telegraph system, which consists in momentarily diminishing the normal resistance in the artificial line simultaneously with the act of charging the main line. (2) The method, substantially as hereinbefore set forth, of counterbalancing the effects of the current of charge in a duplex telegraph system, which consists in withdrawing an adjustable rheostat from the artificial line by the same movement of the transmitter which admits the current of charge to the main line. (3) The combination, substantially as hereinbefore set forth, of a main

238,094

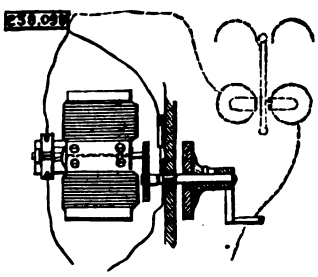


line, an artificial line, and a key or transmitter provided with two sets of circuit closers arranged to act simultaneously, one to connect the battery with the main and artificial lines, and the other to shunt a portion of the resistance in the artificial line. (4) The combination, substantially as hereinbefore set forth, of a rheostat normally constituting a portion of the artificial line, a shunt circuit passing round said rheostat, and a circuit closer for completing said shunt circuit, which is attached to or operated simultaneously with the lever of the transmitter. (5) The combination, substantially as hereinbefore set forth, of the transmitter arm, the reciprocating weighted shuttle, moving with slight friction between adjustable stops, and by its inertia having a greater range of vibration than the transmitter arm, and the contact points upon the said shuttle facing the transmitter arm.

238,098. MAGNETO SIGNAL APPARATUS, *Thomas A. Edison and Edward H. Johnson, Menlo Park, N.J.—Filed November 11th*, 1880.

Brief.—Turning the handle of the magneto-generator in one direction breaks continuously a short circuit around the machine, while turning in the opposite direction breaks said short circuit only at definite intervals. *Claim.*—(1) The combination, with a magneto machine and its main circuit, of a shunt or short circuit, and means for automatically breaking such short circuit entirely upon movement in one direction and intermittently breaking it upon movement in the other direction, substantially as set forth. (2) The combination of a driving shaft of a magneto-electric machine, a sleeve mounted thereon in

238,098



such manner as to have a determinate longitudinal movement thereon, and a circuit breaker automatically operated by such sleeve, to break a circuit entirely during movement in one direction and intermittently during movement in the other direction, substantially as set forth. (3) The combination, with a magneto machine, of means, substantially as described, for producing a definite audible signal upon rotation of the driving shaft in one direction, and a definite different audible signal upon rotation of the driving shaft in another direction, substantially as set forth.

238,195. WIRE FOR TELEPHONES, *David Brooks, Philadelphia, Pa.—Filed March 4th*, 1878.

Claim.—The combination of a telephone wire with an additional metallic wire running parallel with the said telephone wire, and in close prox-

238,195

imity thereto, but insulated therefrom, the wires being connected at each end to complete the metalic circuit, substantially as set forth.

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ELECTRIC LIGHTING FOR THE CITY OF LONDON.

By the time these lines are in the hands of our readers an experiment will have commenced which has been long looked forward to, and upon the result of which may greatly depend the future of the electric light for street illumination. As evening approaches on the 1st of April the time-honoured city lamp-lighter will either forego his accustomed rounds, or incur the humiliation which too often befalls the unwary on that particular day. Over the largest and busiest area of London's proper boundaries electric fire, kindled by unseen hands, will suddenly assume the place where gas has reigned supreme. The fate that overtook the oil lamp and the link boy seems to be impending over their sometime successful enemy, and from days, or rather nights, of gloom and peril we have arrived at an epoch when, if we cannot outshine the sun, we may at least dispense with the moon.

It cannot be said that electric light—the latest claimant for public service—has any strong prejudices to overcome in favour of its elder rival; for, after taking not an unreasonably long time for consideration, the City Corporation has granted an opportunity for testing their respective merits in a manner as full and free as could possibly be desired. But nowhere, perhaps, could the trial be so severe as in the heart of the metropolis, or the natural difficulties so hard to overcome. The feeling of curiosity with which this experiment is being watched is therefore not unmingled with anxiety, lest the special hindrances to complete success in this instance should endanger the general claims of electric lighting to popular acceptance. Nevertheless, there is reason for confidence in the energetic and workmanlike way in which the arrangements, at all events in one district, have been carried out, and as the several areas are apportioned with some regard to the special qualities of the systems to be employed, failure, if failure there is any, will not be due to want of painstaking or foresight.

Our readers are aware that a number of railway depôts, both passenger and goods, in this country as well as on the Continent and in the United States, are now using the electric light. In some of these cases gaslight has been entirely, or almost entirely, superseded, and the reports are everywhere highly encouraging. But its application to purposes of this kind in no way corresponds with the demands upon electricity as an illuminator of the intricacies of public thoroughfares. The nearest resemblance to the experiments now being tried from London Bridge to Blackfriars, along some of the narrowest as well as the widest channels of City traffic, is seen in the main thoroughfares converging at the Opera House in Paris, and upon the Thames Embankment in London. For these, however, the requirements were exceedingly simple. Given a straight line, of uniform width, the number of lamps and their appropriate intervals were easily ascertainable. Neither of the localities named were much frequented, and in neither is there any approach to crowding. It seemed, indeed, as if places had been chosen where failure would occasion least inconvenience; and on the whole the effect was to make the comparative solitudes more cheerless and deserted. The lights were unexceptionable, and the spectacle was charming, but beyond this nothing could be certainly predicted. What we are now about to witness is an enterprise of quite a different stamp. The lines of route are not the lovers' walk of the Embankment, nor the café and restaurant illuminated pavements of gay Paris, but places where business—even the business of pleasure—almost ceases after dark, and where the endless stream of London life, hurrying eastward and westward, to north and to south, hustles its way along the footpath, or is steered as best it can on the lumbering omnibus or inside the reckless Hansom. People going from places of business to their homes jostle against people going from their homes to places of amusement; and all alike, from sunset to midnight, are compelled at some point or other to run the gauntlet of a troop of flying charioteers whose special privilege it is at that hour to "charge" you remorselessly, though in different ways, whether you ride upon wheels or venture to put foot upon the roadway. The City, as that part of London is called which leads to and from everywhere, is a conglomeration of zigzags and hazardous crossings, and, moreover, except perhaps the immediate vicinity of theatres at closing time, is the most thronged. Added to this, the pavements are narrow, and so are the streets, whilst the open spaces, which have to be traversed somehow, are many and wide. The buildings are of huge dimensions, and, unlike those of Paris, which might have been cast in a mould for uniformity, are unequal, rugged, and, though exceedingly picturesque, are not capable of any sort of regular illumination. All this, and more that we could name, tends to make the task of lighting with a medium giving intense and sharply-defined shadows one of considerable difficulty. From an inspection of the arrangements so far completed, however, we should say that there

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will be no lack of light, and that, on the whole, the situations are well chosen.

The Southwark Bridge and Queen-street district, including a portion of Queen Victoria-street, will not be lighted for some time to come, the Lontin Company, failing the Electric and Magnetic Company, not yet having made much progress. The Anglo-American Company have almost completed their arrangements for lighting from Blackfriars Bridge, Ludgate Hill, and St. Paul's, to Cheapside. In the third district, to all appearance, the London Bridge to Guildhall route, was covered some days ago; and as this embraces King William-street, the Mansion House, and the Royal Exchange, it is the most important system of the three. We reserve our description of the schemes as a whole until they are seen in actual operation. All we need say at present is that the lamps are well placed, and, with one exception, admirably designed. London Bridge itself is liberally provided, and the addition that has had to be made to the existing gas-lamps is neither unwieldly nor inartistic. The street lamps, too, are well-proportioned and appropriate. The same can hardly be said of the high lights overlooking King William statue, the Exchange flags, the flank of the Mansion House, and the middle of Guildhall yard. They are not dangerous, as some member of the City Commissioners seems to fear, but they are decidedly incongruous. For a time the novelty of the long-looked-for experiment may shut out all other considerations; but we cannot conceal our apprehensions that even City taste may in a little while rebel against disfigurements so palpable and, we hope, so needless. In that case we make no doubt that the ingenuity of the contractors is equal to their boldness, and that some less objectionable means may be devised for overhead lighting of the open spaces. To those who are interested in the promotion of electric lighting for town thoroughfares this excellent opportunity for studying the subject, and marking its good and bad points, will be of immense service; and with a fair amount of success attending it in the very centre of the greatest city in Europe its extension to other quarters and by other hands is only a question of time. More satisfaction would have been generally felt if local and national enterprise had had its share in this undertaking, and notably the rejection of Crompton's tender is still a mystery requiring explanation; but the field is wide, and for that as for every other system possessing any merit there is, we believe, a very promising future.

A LIBERAL OFFER.

A Prize of Twenty-Five Pounds to be Awarded concerning the Nature of Electricity by the Congress at Paris.

To M. Georges Berger, Palais des Champs Elysée, Paris.

Sir: I offer to place the sum of twenty-five pounds at the disposal of the Congress of Electricians for the above purpose, on the following conditions:—

In the year 1839 I published in the *Greenock Advertiser* a letter about electricity, a copy of which I sent to Professor Faraday, M. Arago, and many other electricians of that date. In it I described a discovery I had made of knowing the direction in which a current of frictional electricity moves. This was attained by means of the direction in which an insulated coal-gas flame bends when placed in an electric current. With the assistance of the insulated gas-flame I was enabled to prove that there is only one electricity. At that date electricians maintained, and some have since maintained, that there are two electricities. They say that, when a frictional electrical machine is put in motion, one kind of electricity is given out at the prime conductor of the machine, and that another kind of electricity is given out at the cushion end of the machine. This is not true. By the use of the insulated gas-flame I proved that a current of electricity issues from the prime conductor of the machine, and that no current of electricity issues from the cushion-end of the machine; on the contrary, the insulated gas-flame shows that a current of electricity goes into the cushion end of the machine from the ground or surrounding objects. In other words, the machine draws in electricity at the one end and gives it out at the other. There are not two electricities.

I maintain that I established in 1839 that there is only one electricity. All substances have it within them in an imperceptible state, or in a state of surcharge in relation to surrounding objects, or in a state of depletion in relation to surrounding objects. I now offer the sum of twenty-five pounds as a prize for the discovery of the nature of electricity; and especially for the discovery of the reason why electricity unites itself into the form of a spark as it leaves the prime conductor of a frictional machine.

Suppose a frictional electrical machine, having its prime conductor made of a large ball of metal, insulated. When the machine is set in motion electricity begins to accumulate on the ball, and distributes itself equally all round. In this state the electricity is invisible. If another metallic ball, which is not insulated, be brought near to the insulated one, instantly the invisible electricity becomes visible in the form of a concentrated accumulation of electricity which is called a spark, and it rushes through the air to the uninsulated ball, by the metal of which it had been attracted. This visible presence of the electricity—the light—is the concentration of the electricity to such an extent that the air passed through is burned and light appears, just the same as when a copper or platinum wire are burned by the passage through them of more electricity than their attraction of cohesion can endure. What I wish to direct attention to is the starting point in the formation of the electric spark. Whatever prejudices some electricians may still have in favour of the theory of two electricities, it is self-evident that there can be only one kind of electricity on the surface of the prime conductor of the frictional machine—the insulated ball. Hence there is no room for talk about polarity in this case. It is equally self-evident that an electric spark formed at a spot on that ball is a mass of one kind of electricity which was previously scattered or spread over the surface of the ball in an invisible state. By what force was the invisible, scattered electricity made to form the mass called a spark? I maintain that the attraction of the particles for one another of the scattered electricity must be the force which draws them together into the compact form of a spark. Hence, if the formation of the spark is done by attraction between the particles of electricity, there cannot exist repulsion between the particles of electricity, and all the phenomena which appear to arise from repulsion of frictional electricity are really caused by the attraction of surrounding matter for the surcharge of electricity on the objects which receded from one another.

Any electrician who thinks he can give a better reason for the formation of the frictional electric spark than that of attraction between the particles of electricity on the insulated ball is requested to give in his answer to you in writing on or before the 9th September, 1881.

I have to request that at a meeting of the Congress previously notified to the members a committee be chosen by the Congress, of seven electricians, to examine the answers and award the prize if an answer sent to you be, in the opinion of the committee, a better one than that of the formation of the spark by attraction between the particles of electricity on the insulated ball.—I am, yours faithfully, James Johnstone.

Office: 1, James-square, Edinburgh, 16th March, 1881.

(Translation.)

Telegraph and Postmaster General's Office, International Electric Exhibition, under the Patronage of the State, Paris, 19th March, 1881.

Sir: I have read with much interest the letter which you did me the honour of writing to me, dated the 16th March, 1881.

I fully appreciate your high-mindedness and sympathetic interest towards the branch of physical science especially connected with electricity, and I cannot sufficiently thank you for your generous intentions.

The opening of the International Congress of Electricians will only take place in Paris on the 15th September, 1881. I shall take the very first opportunity on its first sitting to place your proposal before the Congress, and I have no doubt that it will be welcomed with the gratitude which it deserves.

In the meantime and until next September I place myself entirely at your disposal for anything in which I may prove useful or agreeable to you.

(Signed) G. Berger,
Chairman of the Exhibition Committee,

James Johnstone, Esq., Edinburgh.

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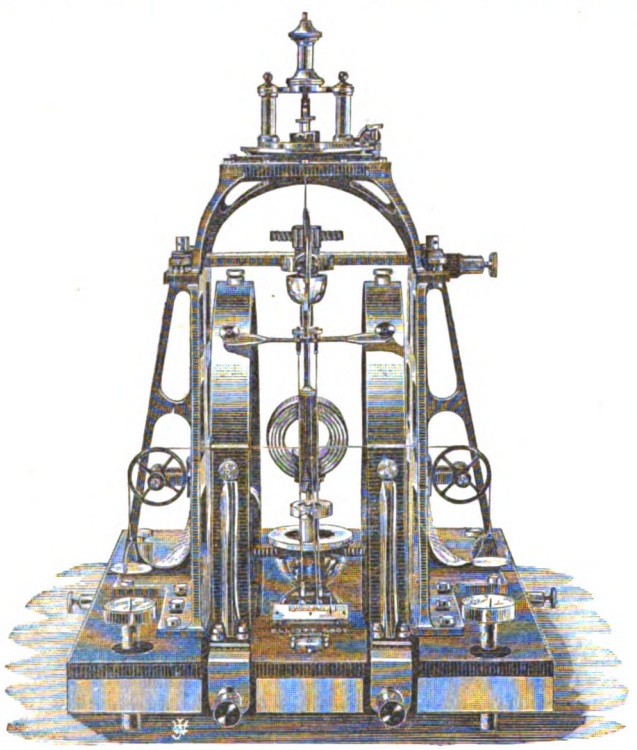
MEASURING ELECTRIC CURRENTS OF GREAT STRENGTH.

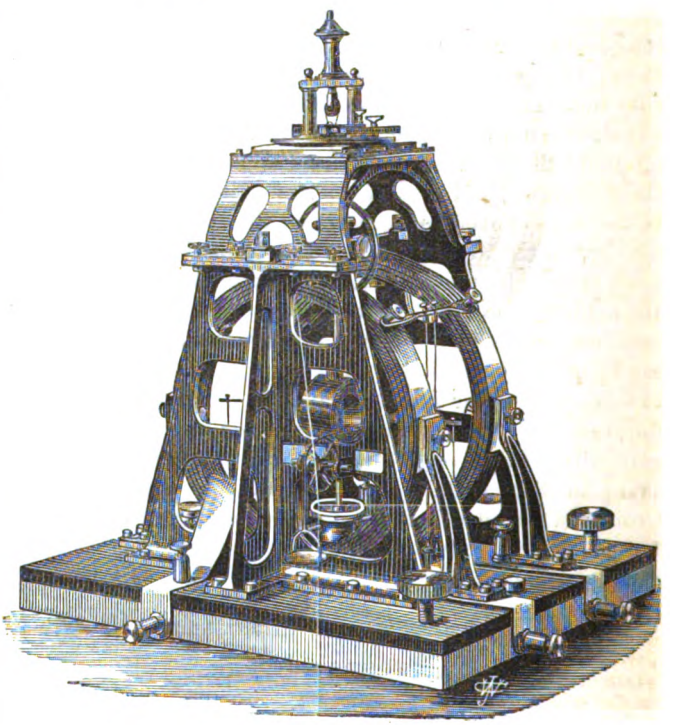
In his third Cantor lecture, Professor Adams, F.R.S., briefly referred to an instrument which was just finished by Messrs. Elliott Brothers for an American order. Messrs. Elliott have gained a well-deserved reputation for the construction of electrical and similar instruments, but we doubt if they have ever constructed an instrument which redounds more to their credit than the one we are now able by their courtesy to describe.

The Proceedings of the American Academy of Arts and Sciences for 1878-9 contains a paper by Professor J. Trowbridge dealing with the measurement of electrical currents of great strength, and comparing the Wilde, Gramme, and Siemens machines. In this paper Professor Trowbridge describes an electro-dynamometer to measure the whole current from such machines as those above mentioned. He points out the disadvantages of (1) the galvanometric method, (2) the electrometer method, and (3) the heat method, and gives the results of his experiments on the machines named with the electro-dynamometer he had designed.

In January, 1880, Mr. W. N. Hill contributed a paper to the *American Journal of Science*, in which he describes certain modifications in Trowbridge's instrument. In this paper Mr. Hill says :—"The method of employing the electro-dynamometer is to be preferred for many reasons, and it has also the advantage of being applicable to to-and-fro currents, as well as to those in one direction. Weber's form of the electro-dynamometer is an instrument which, as Clerk Maxwell says, 'is probably the best fitted for absolute measurements.' In this one coil is suspended within another, the suspension being a fine wire, through which the current is led to the suspended coil. It is, therefore, only suitable for the direct measurement of very small currents. If currents of greater strength are employed, the suspended wire is heated and elongated. It is consequently necessary, in measuring powerful currents with Weber's electro-dynamometer, to use very large shunts. It is very desirable to avoid the use of shunts, since the entire resistance of the circuit is of the same order of magnitude as the shunt. In general, a method depending upon the measurement of a *very small proportional part* of the whole current is objectionable, since very great accuracy is necessary, and errors of observation are exaggerated. Trowbridge has designed an electro-dynamomter through which large currents may be transmitted and directly measured. It consists (*vide* Figures) essentially of two large fixed coils made from copper bands, between which is suspended, from a torsion head, a small coil, the whole so arranged that by mercury connections the entire current will traverse the smaller coil as well as the large ones. A small mirror is attached to the deflecting coil, and by means of a telescope and scale, the deflections may be read. In practice, however, it is found that the better mode of observation is to bring back, by the torsion head, the coil to the zero point determined by the telescope scale and mirror. This instrument gives good results. Measurements can be made more rapidly with it than by the galvanometric method and without shunting." Mr. Hill made some modifications in the manner of observing and determining the deflection power of the current. The instrument made by Messrs. Elliott, and which we now illustrate, contains these various modifications. In our next issue we shall further illustrate the details of the instrument, so that we will now confine ourselves principally to theory. We must, however, point out that when the current passes the suspended coil is powerfully deflected, but its movement is limited by a vertical wire stop. There are two of these stops, one on each side of the pointer-rod of the suspended coil. To the pointer-rod are attached on opposite sides two silk threads, which lead over pulleys on the side bars to small scale pans, as shown. Where deflection takes place weights are added as required, to bring the pointer-rod back to zero. The weight employed exactly balances the magnetic force. Both Professor Trowbridge, in his paper, and Mr. Hill, in his paper, give the theory of the instrument, and we quote from Mr. Hill :—"The expression for the strength of the current is very simple. The weight found is that required to balance the deflective force observed at zero, so that the earth's and local attractions are avoided, nor does the torsion of the suspension enter. Let

S = strength of current in webers.
w = weight used in milligrams.
l = length of weight, arm, or distance from point where weight acts to centre of system.
G = constant of large coils.
g = constant of small coil.
C = constant of instrument or length of magnetic arm.





"By the theory of the electro-dynamometer, the force acting to deflect is represented by the expression $\frac{2\pi n}{r} . g . S^2$, in which $\frac{2\pi n}{r}$ is the constant of the large coils or G, and g the constant of deflecting coil. This force acts with the arm C, and is balanced by the weight acting with arm l. Hence

$$S^2 = \frac{l w}{C G g}.$$

"The coils being large, G and g are readily ascertained by measurement; l is a known distance; C is the constant of the instrument, and must be specially determined; C, l, G and g being known it is evident that from weight found the current may be obtained with little calculation, or a table may be made so as to obtain the values desired by inspection." Mr. Hill constructed tables to use with his instrument, but it is clear that tables constructed for one instrument will not answer when employed on calculation with another instrument, so the best plan for the lucky possessor of an instrument of this kind would be to calculate his constants and make out a table for future reference. The

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deflections of the instrument are powerful, and thus the weights are large enough to give sufficient sensitiveness. Mr. Hill points out that a set of weights could be made which would represent webers current, making calculation unnecessary. With his instrument he worked with currents as small as 10 webers, but found it insufficiently sensitive for such small currents. It worked satisfactorily with currents above 20 vebers. "It is evident, however, that this form of dynamometer is particularly suitable for *large* currents. We have $S : S^1 :: \sqrt{w} : \sqrt{w^1}$. That is, as the currents increase, the corresponding weights increase more rapidly, and greater accuracy and minuteness are attained."

LESSONS FOR LEARNERS.

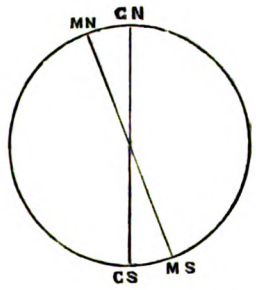
(CONTINUED FROM PAGE 179.)

The form of galvanometer we have before us is that known as the tangent galvanometer. You see here is a short magnetic needle which moves as currents are sent into these coils. The needle is between two sets of coils, one set on each side. The coils, again, are of two kinds; here is a coil on this side of thick wire, and a similar one on the other side, while these coils are of much smaller wire, and the turns of wire in the coil are numerous, as is also the case in the similar set on the other side. We will, however, for the moment direct our attention to the needle. As we have seen, a needle places itself, if left free

(The form of tangent galvanometer here illustrated is that constructed by Messrs. Elliott.)

to move, in a certain direction. This results from some action upon the needle, and, for want of knowing more about the real cause, we say the direction is taken because of the influence of the earth's magnetism. Now, whatever the cause, the effect is just as if the needle were acted on by two equal and opposite forces—that is, the whole arrangement forms a "couple." The earth acts upon this needle as if it were a magnet, with one pole at the present time a little to the west of the geographical North Pole, and with the other pole a little to the east of the geographical South Pole.

If in this diagram G N represent the geographic north and south respectively, and M N and M S the magnetic north and south, a needle would, if free to move horizontally, place itself



in a line parallel to M N, M S, and if moved out of that position would tend to go back to it, and, if left free to move, would, after a few oscillations, regain that position.

I think you will get a better idea of this action if you try and follow an experiment. Here is a round table, and here a long light steel pointer with small holes near the ends. The pointer is nicely balanced upon this pivot at the centre of the table. It turns very easily, and, not being a magnet, stops wherever I like to place it. I have here two pulleys, which also move very easily, and turn easily at right angles to the wheel. I pass this piece of cord through one of the holes in the pointer, make a knot so that it cannot come through further, fix a weight at the end, and let the weight hang over this pulley clamped on this side the table. I fix the other pulley on the opposite side of the table, and fasten a similar weight by similar means to the other end of the pointer. The weights are now acting in exactly opposite directions, and, being equal, there is no tendency to move the pointer. I now move the end of the pointer a little to one side, and you notice the direction of the cords between the end of the pointer and the pulley wheel. The pointer originally rested directly over this line on the table. I let it go, and you see it swings back to the line under the influence of the weights, then a little way past, now back again and over the line this way, and now with a few quick oscillations just over the line it comes to rest above the line. This action, as I say, is somewhat similar to that of the earth's magnetism upon a magnet. The north magnetic pole of the earth pulls one end of the needle and pushes the other, these two forces being equal and opposite, while the earth's south magnetic pole pulls the end of the magnet pushed by the north magnetic pole of the earth and pulls the other end. These forces are again equal and opposite. The whole set of forces act as a couple, and have a directive influence only on the needle. I might say here that, we being in the northern hemisphere, and therefore farther away from the earth's south magnetic pole than from the north magnetic pole, if the needle could move in a vertical as well as in an horizontal direction, the end pointing towards the north would be pulled towards the ground, that is, the needle would not be parallel to the surface of the earth, or, better, the surface of the sea. These questions, however, may interest us at another time. I want you now to understand that the needle of this galvanometer is still influenced by the earth's magnetism, and if I send a current through the coils causing the needle to turn through any angle, the current through the coils is opposed by the directive influence of the earth's action, which tends to bring the needle back to its normal position.

I can send the current through the coils in various ways. If I have a very strong current I connect through the large wire; if I have a weaker current, but still fairly strong, I send through a section only of the coils of small size wire on either side. If I have a weak current I use the whole of the coils of smaller sized wire. As we have previously seen, each turn exerts its effect upon the wire, and the small effect of the current through one wire is multiplied by using a number, that is my reason for using the whole of the turns of the wire for the weakest current.

Unless the needle is a mere point the effect of the current upon the needle is not the same in its varying positions. The error arising from this defect in the instrument is not very great providing the diameter of the coil is about ten times the length of the needle.

The law which we have to follow in using this instrument is that the strengths of the currents passing through the coils are proportional to the tangents of the angles of deviation of the needle. In order to use the instrument it is not necessary that you should have a knowledge of trigonometry; so much the better, however, if you have the knowledge, but the arithmetical values of the tangents will be found in most books containing logarithm tables under the head of "natural tangents," and these values can be sought when required. A few examples which we can work together will enable you to use these tables of values with ease.

(TO BE CONTINUED.)

RADIANT ENERGY.

The following additional note from Mr. Preece to his paper on "The Conversion of Radiant Energy into Sonorous Vibrations" has been received by the Royal Society:—

Professor Stokes has suggested that the action is due not to the expansion of the contained vapour, through its absorption of thermometric heat generated on the lamp-black surface, but to the contact of the air molecules with this surface. It is clear that when the carbon is warmed, the rapidly moving air molecules which strike it and bound off have their retreating motion increased in velocity. This increased velocity means increased

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pressure, which in its turn produces increased volume, and this, when intermittent, produces sonorous vibrations. This explanation is quite in accordance with the observed facts, for the difference of the intensity of the sounds emitted by dry air and air charged with absorbent vapours is very much less when a lamp-black surface is used, than was anticipated. Dry air gives excellent results with lamp-black, but is silent without it. Indeed, it leads one to conceive that, as charging the air with heavy smoke produces the same effect as coating the containing surface with lamp-black, each particle of smoke becomes a warmed surface from which the colliding air molecules, whose dimensions are infinitely smaller, retreat with increased velocity. Moreover, if we conceive the smoke particles replaced by the compound molecules of absorbent vapours, such as sulphuric ether, olefiant gas, or ammonia, and if we assume the dimensions of these molecules greater than those of the air, we have an explanation not only of the absorbent power of these gases, but of the reasons for their behaviour in converting radiant energy into sonorous vibrations. It is clear that, if the compound molecule act as a smoke particle, the radiant energy becomes degraded into thermometric heat, for the motion of the ether is transferred to the motion of the molecule. The minute air molecules move unaffected in the undulating ether, but the larger compound molecules of the absorbent gas take up the waves of the ether, and assume that form of motion which is known as thermometric heat. Hence, the greater the number of molecules and the larger their dimensions, the greater the absorption of heat, and the more the production of sonorous vibrations, for a greater number of air atoms will collide with warm surfaces in a given time. That this assumption is justfied is proved by the fact that this absorption of radiant energy renders the particles of dissociated nitrite of amyl and other vapours visible as well as warm, and, therefore, they can assume dimensions that are comparable with the particles of smoke.

STUDENTS' COLUMN.

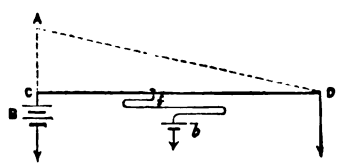
We insert the following as an apparent paradox in the case of the combination of two batteries :—

Let C D be a homogeneous conductor inserted between the battery B and earth. A smaller battery, *b*, with one pole earthed, may be connected to any point along C D by means of a flexible conductor, *f*. The similar poles of the two batteries are to earth, but B consists of, say, 20, and *b* of 10 cells.

If, now, the flexible conductor *f* is applied to the point D, a current will flow from the battery *b* to D and earth, for *b* is clearly "short-circuited."

If, again, *f* be applied to the point C, a current will flow from C through the battery *b* in a direction the reverse of that in which *b's* current tends to flow, because the unequal batteries B and *b* are now unopposed.

There must, therefore, exist along CD some point at which if *f* be applied no current will flow through *b* in either direction. This will clearly be found where the perpendicular distance from CD to the potential line AD is equal to the E.M.F. of battery *b* expressed in the same units of length as the potential CA. In fact the potential at the point in question will be that of the free pole of *b*.



Hence it follows that as cells are added to battery *b*, and its E.M.F. increased, the point at which contact between *f* and CD produces no current in *b* will be found nearer and nearer C.

The apparent inference is, therefore, that when B and *b* are both 20 cell batteries—*i.e.*, when their E.M. forces are equal—that *f* will have to make contact with the point C before a current ceases entirely in the circuit of *b*. This is equivalent to saying that the battery B sends a current through the circuit BCD, while its equal *b*, connected to the circuit at the point *c*, neither sends nor receives any current—or that two batteries connected "for quantity" with the same poles to "line," will *not* both work. An absurd conclusion.

The apparent anomaly lies in the fact that the potential CA is not the potential of the free pole of B, but lower than that quantity, because resistance has been offered and been overcome in the battery itself by the current, so that at the point C the potential is reduced. When, therefore, *f* is connected to *c* the E. M. F. of the battery must exceed the potential CA, and a current must flow from *b* to D and earth. An application of Kirchoff's law will readily show the currents then flowing from B and *b* to be equal.

E. A. K.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

At the meeting held on the 24th ult., Professor Foster, who was in the chair, announced that an invitation had been sent to Professor Helmholtz, asking him to visit the Society while staying in London, and that it was expected he would do the members this honour. The evening suggested was that of Monday, the 11th inst., but due notice would be given of the final arrangements.

A paper was then read by the Secretary on

The Telegraphs in Japan.

This was a communication from Mr. J. Morris, the Society's correspondent in Japan, and gave an interesting account of the progress of telegraph construction and development in that country since its first introduction ten or eleven years ago. Previous to that period Japan was little known, and the interior had never been explored. No sooner, however, did the political events which led to the admission of Europeans enable the natives to see the advantages to be gained by closer relations with western civilisation than railways, telegraphs, and engineering operations of various kinds sprung into existence. Considering the conservative character of the people, their opposition to new ideas, and their hatred of foreigners, it was extremely surprising that this peaceful revolution had been accomplished in so short a time; and the aptitude they had displayed for mastering the scientific principles of these new industries was even more remarkable. The case of the telegraph was a conspicuous illustration of this. In 1869, the first short length of telegraph wire was laid, and was worked by Briguet alphabetical instruments. Two years later a general system of telegraphs for the whole country was inaugurated, and the Morse instrument—a Siemens single current—came into use. Very soon the entire length of the island was covered, and every place of importance put in possession of telegraphic communication. The chief difficulties of construction were the absence of suitable timber, and the presence of wide rivers, or rather beds of rivers, which had to be spanned as best they could. Labour, however, was cheap, and it was found cheaper to replace the poles than to bring more durable timber from long distances, or to apply any serviceable protection in the shape of creosoting. A species of cedar was the cheapest and best wood to be had near the routes; and, subjected to a simple tarring, poles of this description lasted from four to six years. The other difficulty was not so easily overcome. In summer and autumn the inland waters swept seawards over shallow courses of great width; and there being nothing but sand and loose stone for bottom, piles had to be driven to a considerable extent and depth during the winter months, when the streams are dried up, so as to secure a footing for masts at suitable intervals, across which the wires were spanned. Typhoons play sad havoc with these at times; but the linemen, who are stationed at short distances apart along the main routes, are quickly at the work of repairing, and the average duration of breakages compares favourably with the European systems. Five such wires connect the capital with the south. The electrical condition of the lines, too, is well cared for, the local spider, a creature of prodigious size and industry, being the chief cause of trouble in this particular. Porcelain insulators of very superior quality are manufactured locally, the material being obtained from a spot previously held sacred to the uses of the King's palace.

The Japanese, who are a shrewd as well as an ingenious people, appear to have contemplated managing their telegraphic affairs for themselves from the very first. They obtained English teachers, who performed their duties so thoroughly that now there are scarcely any teachers or scholars who are not Japanese. Not only have they learnt the scientific part of the business, but they manufacture well-nigh everything required in it. Some interesting specimens of their handiwork in the shape of porous cells, battery troughs, insulators, and copper wire accompanied the paper, and were much admired by the audience.

Samples of lacquered wire were especially noticed as being a possible substitute for the more costly silken or cotton-covered wire. A more thorough working of the mining riches of the country will result probably in all machinery and apparatus being added to the number of local industries.

Notwithstanding its very low rates, the Japanese telegraph now pays its way; and when we learn that a message of twenty words can be sent a distance of twenty miles for 2½d., this con-

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dition of the finances speaks well for the patronage that has been bestowed upon the system by the people. On the part of the military authorities its value was recognised at once. In a recent rebellious outbreak the telegraph followed the troops wherever they went, portable posts, ebonite insulators, and No. 11 wire forming part of the military stores, the result being that the rebels were checkmated and beaten at every turn. One other effect, of a more peaceful kind, has followed the introduction of the telegraph in this peculiarly Oriental country. Scarcity of rice—its staple article of food—is of frequent occurrence, and to provide against famine a supply equal to one and a half year's consumption had to be always kept in store. Now, however, that the remote regions can make known their probable requirements without delay, this large stock of food need no longer lie idle. Probably in no country has the telegraph conferred so many benefits in so short a time as in Japan.

Some interesting information with regard to Chinese telegraphs was afforded the meeting by Mr. J. A. Betts, who had been instrumental in erecting the first telegraphs for the Chinese military stations on the Pei-Ho river. He had experienced no difficulties in overcoming the commonly supposed Celestrial prejudices against innovations of this kind, and he predicted a great future for China as a field for European enterprise of all kinds.

After some appropriate observations from Mr. W. H. Preece, who proposed a vote of thanks to Mr. Morris and to the native inventor who submitted the articles above referred to, but whose name was not easily deciphered, the meeting adjourned until the 14th inst., when a paper will be read by Mr. Lane Fox on "Electric Lighting," &c.

BROWN AND BOGEN'S AUTOMATIC FIRE DETECTOR.

It is a well-known fact that all bodies expand or increase in volume when exposed to heat, and that cold will cause them to contract. Quicksilver is used for thermometers in order to measure, by its great expansiveness, the temperature of the air, and its metallic thread has been employed for years in fire alarms to announce a dangerous maximum of heat by making contact with a platinum wire attached to a battery and causing a bell to ring; but such forms of fire alarm may now be looked upon as abandoned, in consequence of their uncertainty and liability to give false warning. This same principle of expansion of metals has been employed in the metallic thermometer, an instrument composed of two metallic strips soldered together, one end of which is free to move over a scale to indicate the temperature of the air. These thermometers have been employed to a far greater extent than those of quicksilver for the purpose of fire alarms, but they are apt to give false alarms or none at all.

In the detector of Mr. R. T. Brown, late superintendent of West India and Panama Telegraphs, the same principle of expansion has been applied in a very ingenious and novel manner. The sensitive part of the apparatus consists of two straight compound blades, each blade being composed of two strips of different metals soldered together in such a manner that when heated the compound blades will become somewhat curved. These two blades are placed side by side, and parallel the one to the other. At one end they are attached to insulated supports, and at the other end one blade is provided with a contact screw by which it makes contact with an arm provided upon the other blade. Adjusting screws are also provided to press upon the blades near their attachments to the insulated supports for the minute regulation of the contact between the blades and their other ends. One of the compound blades is provided with a sheath of paper, but the other is left bare. The whole of these parts are contained within a metal cage, which serves to protect them from mechanical injury. One or more of these detectors is placed in each warehouse, room, or place where protection may be necessary, and each is connected with a battery, an electric bell, and an indicator, so that an electric current continues to flow through the detector as long as the two blades of the instrument continue in metallic contact. When a fire occurs the detector acts in either of two ways, according to that in which the fire operates upon it. If a sudden rise of temperature (even of a few degrees) occurs, the bare blade of the detector is acted on more rapidly than the blade which has the protecting sheath, and becoming more curved than the other the contact between the blades ceases, and an alarm on an electric bell is given which operates upon an electrical indicator, causing a little disc to fall, and thus denote the exact locality of the fire.

On the other hand, if the rise of temperature be very gradual, but extends beyond the range of natural temperatures, then both blades move together with the gradual rise of temperature until one of the blades comes against the screw F, which can be adjusted to any pre-arranged temperature, and is thus mechanically stopped. The other blade then continues to move, becoming more curved under the influence of the increasing temperature, until the contact between the blades is thus separated, with the result that the bell is caused to ring, and the indicator disc denotes the exact locality of the fire as before described.

We have recently witnessed the apparatus in operation, and it works admirably. It is, so far as we are aware, the only detector that can distinguish between a sudden heating due to actual combustion and a slow rise of temperature due to the weather or lights in the room.

Its principal advantages are, briefly, that it gives immediate notice by ringing a bell of any outbreak of fire before the normal temperature, whatever it be, has time to rise beyond a few degrees (8° to 10° Fahr), and the exact locality of the fire is at once shown by the indicator. No false alarm will be caused through an excess of summer heat, the high temperature produced by numerous gas lights, fire stoves, steam pipes, &c. Any attempt to cut the wires for incendiary purposes is instantly announced by the ringing of the bell. It is automatically arranged for extreme climates. In Polar regions it would give an alarm of fire before the temperature could rise above the freezing point, while in the tropics it would give no alarm, although the heat might be almost unbearable, unless fire were present.

It is evident from the foregoing that by means of this automatic fire detector an outbreak of fire may be speedily subdued if the person in charge of the apparatus has at his disposal an extincteur, or even a bucket of water. For ships and bonded warehouses, as well as private residences, factories, and stores, it cannot but be a valuable appliance.

THE CONTACT AND CHEMICAL THEORIES OF ELECTRICITY.—I.

BY J. T. SPRAGUE.

Ever since the first discovery of that form of electricity which we now call "dynamic" two theories have been maintained as accounting for its production. One school of electricians, following Volta, have attributed the origination of electrical currents to a "force" due to *contact*; the other school, following Galvani, have attributed this origin to the *reaction of chemical affinities*. Until quite recently nearly all English electricians have adopted the chemical theory, in the belief that Faraday had clearly demonstrated both the utter baselessness of the contact theory, and also the fact that without chemical action no electricity was developed in the only source of current electricity known till recently—that is to say, in any form of battery.

But in our new source of electricity, the dynamo machine, we do apparently obtain enormous currents of electricity without chemical agency, and this may to some extent explain the revival of the contact theory. But it is very certain that in these machines the source of electricity is in no way "contact," and when we look a little further we find that it may be, in fact, commonly traced to chemical action, because its actual source is unquestionably the consumption of coal—that is to say, the chemical reaction of oxygen on carbon and hydrogen. The one thing, however, which these machines prove is that electricity is derivable from "energy," and that the source of that energy does not affect the production of electricity. Now, we are in the habit of making a very clear distinction between static electricity and dynamic electricity, and it is mainly from the experiments in the field of static electricity that the upholders of the contact theory seek for their evidences. I fear I am going to shock the feelings of the great majority of electricians, and to lay myself open (not for the first time) to the charge of desperate heresy.

Static Electricity has no Existence.

Every evidence we have of the presence of electricity is a testimony to its dynamic condition, for we have no evidence other than the production of *motion* of some kind. Static electricity, as we study it, is simply electricity acting through nearly infinitesimal conductivity, or in what we should call technically, circuits of enormous resistances. But while motion *may* indicate a "force" in action, and, of course, must do so according to the artificial and mathematical laws to which we reduce the operations of nature, it is certain that it *must* indicate a transfer and action of "energy," and hence we are gradually learning that the actions of static electricity are simply the actions of energy

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traversing what we may conveniently call "fields of force." Of course, I only glance here at such a massive subject as that indicated in this paragraph. My only present purpose is to point out that "energy" is an essential condition of electrical action however displayed and whence-soever derived.

However, the consideration of the contact and chemical theories must be confined to their proper limit, actions derived from batteries, or, rather, arising in circuits in which chemical action is possible; the question actually may be defined as being *whether electrical action arises from chemical actions occurring among the bodies present*, or *whether the chemical action arises because an electrical force is created by the contact of the bodies*. It must be admitted that, so stated, the question seems to be almost one of words, and that there is no practical difference between the two theories. But there is really a vast difference; one involving fundamentally distinctive ideas as to natural actions, and therefore likely to lead to very different practical results. The apparent resemblance arises from the fact that the original contact theory of Volta has been utterly destroyed; the chemical theory, in the hands of Faraday, triumphed when he showed that electricity could not possibly be derived from the contact of the *different metals* of the battery (the true or original contact theory) because it was equally produced when no such contact occurred. But the mathematical mind and system finds it convenient to use and to locate "a force," and never hesitates to invent and use any term or symbol it requires. This is perfectly legitimate in the mathematician's own department, in formulæ and calculations; but, unfortunately, these terms and symbols have a fatal tendency to pass from the abstract state, where they are useful, into the concrete condition, and when they do this, and are received as real facts and explanations of the processes of nature, they become very dangerous. The result has been a modification of the old contact theory of a force due to the contact of different metals into a new theory of "a force due to the contact of all heterogeneous bodies." Under this new form it takes possession of all the facts upon which the chemical theory is based, and apparently the distinction of the two theories becomes one of words.

I will try to define the real distinction.

The contact theory defines (? imagines) a force developed by the contact of two bodies of different nature. This force may, perhaps, be that which is called "potential," or difference of potential. It attributes the origin or the motion of electricity to this force, and regards the accompanying chemical action (when any occurs) as the effect of the force, though it may, and indeed does supply the energy necessary for the work of the circuit. It may also be remarked that this theory actually involves the existence of a distinct electric entity, a fluid or fluids, the action of which originates the force.

The chemical theory attributes the origin or motion of electricity to a force also; but that force is the chemical affinity which holds substances together or breaks them up. According to it the difference of potential is only a term (useful enough) which expresses the difference between the internal and the external affinities of the constituents of substances. The energy set free by the play of these affinities will appear in any of the modes of energy suitable to the conditions of each case; in the suitable conditions it develops a motion of electricity (whatever that may be), and this energy is, as in all other cases, capable of being mathematically expressed in the terms of a force—electromotive force, difference of potential, or whatever other term may be convenient.

Looked at thus, the relations of the theories and the theories themselves may be simply defined in one word.

The contact theory involves an external force and is *atomic*.

The chemical theory involves an internal force and is *molecular*.

The very shadowy and slippery nature of the new contact theory renders it difficult to attack it directly, therefore, in what I may have to say on the subject, I propose mainly to show how perfectly the chemical theory explains the origin of electrical action, while the contact theory is but an artificial explanation. The one treats of the dealings of nature with matter and energy; the other applies to the calculations of the mathematician.

LAYING AND REPAIRING SUBMARINE TELEGRAPH CABLES.*

BY A. JAMIESON, C.E.

I have chosen as the subject of this evening's lecture "The Laying and Repairing of Submarine Telegraph Cables," partly because I have been intimately connected with these operations for the last few years, partly on account of the apparatus exhibited here, and partly from the fact that I believe it will prove new as well as interesting. The subject matter of the lecture will be discussed under the following heads:—

1. The great commercial and political importance of submarine telegraphy.
2. The facilities offered for telegraphic communication with almost all parts of the world.
3. The component parts of a cable, why they have been selected and how they are put together.
4. The general arrangement of a telegraph steamer.
5. The preliminary survey, previous to laying a cable, with a description of Sir W. Thomson's sounding machine.
6. The laying the cable, repairing, &c.

First, the commercial importance of submarine telegraphy is at once apparent when you understand that at the present moment there is £30,000,000 worth of cables lying at the bottom of the ocean, of which £26,000,000 are owned by seventeen private companies.

Of this the Anglo-American Company owns £8,000,000, the Eastern and South African £6,250,000, the Eastern Extension about £3,000,000, and the various other companies smaller amounts, according to the lengths of cables and types employed. These large sums of money have been almost entirely subscribed by private investors, and many of the companies return a very fair and secure dividend on their capital. The political importance arises principally from the fact of Governments (and more especially in the case of the British Government) being able to issue orders to their fleets and armies from head-quarters, as well as to arrange matters connected with colonies and different Governments, in a manner, and in a space of time, that would have been utterly impossible a few years ago without the aid of telegraph cables. This importance has been particularly noticeable during the recent troubles in South Africa, the Government here having been in constant communication with the head-quarters of the army in Natal.

[The routes of the various cables were shown on a large map, and can be followed by the description on any good atlas.]

Let us start from Valentia in Ireland, with which Glasgow is in telegraphic communication, and go westward by the Anglo-American Company's cables to Newfoundland, and from thence to New York, which is in telegraphic communication by land lines with the whole of the North American Continent, including San Francisco. This large company have from first to last had seven transatlantic cables laid between Ireland and America, viz., the 1858, 1865-66, 1866, 1869, 1873, 1875, and 1880. The first four are now unworkable or broken. The last one was completed on the 21st of August last year, and only took twelve days to lay, from Heart's Content (Newfoundland) to Ireland, the quickest, and, perhaps, most successfully laid of all the Atlantic cables, for it is reported that not a single hitch occurred during the operation, to such a pitch of perfection have the engineers, electricians, and captains of the Telegraph Construction and Maintenance Company arrived by continued practice and careful selection of the most approved appliances. This company has laid all the seven Anglo cables, besides more than half the other cables in the world.

This is a very different story from the early trials in 1857, and 1865-66, when submarine telegraphy was in its infancy. If any of you are interested in such operations, you cannot do better than read Dr. Russell's—*The Times* Correspondent—book on the 1865-66 expedition, where you will find the whole matter most lucidly and graphically described. The Direct United States cable and the new French Atlantic cable were laid last year, thus making nine cables in all that have been laid between Europe and America. Considerable rivalry has existed of late between this last cable company and the Anglo and Direct United States Company, in consequence of which the tariff was reduced for some time to sixpence a word (a rate which could never pay), but by some curious "mesmerism" these new companies, as they start up, are seemingly silenced or bought over by the more powerful and monied Anglo Company. We have lately heard of the Yankees starting a couple of cables for themselves, under the wing of Mr. Gould; probably they will fare no better than the French or Direct United States companies have done. We shall now turn eastward, and trace the routes of the Eastern and Eastern Extension companies to India, China and Australia, &c. It may be worth mentioning that Mr. John Pender, M.P., is at the head of these companies, along with Sir James Anderson, another well-known and eminent Scotchman, who commanded the "Great Eastern" during the 1865-66 expeditions.

[The lecturer traced the route from London to India by Porthcurnow, Lisbon, Gibraltar, Malta, Suez, Aden to Singapore, thence onwards to Shanghai, and Japan, to Port Darwin, Melbourne, Sydney, and New Zealand. Also from Aden *viâ* Zan-

* A lecture delivered at the Naval and Marine Engineering Exhibition, Glasgow, January 28, 1881.

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zibar to Natal and Cape Colony. The duplicate and triplicate routes were shown, and the audience reminded of the prudent foresight shown in thus providing separate routes, guarding against possible unfavourable contingencies arising from breakages or wars. The net-work of cables in the eastern part of the Mediterranean was described, ending at Odessa. The Great Northern Company's route through Russia was depicted, as was that of the Western Brazilian, the Brazilian Submarine, &c.]

This finishes the long and more important foreign routes, and you will observe that it only requires a cable to be laid from San Francisco or Vancouver's Island to Japan in order to complete the electric girdle round the earth with Britain's hands on the *buckle*.

It is almost needless, after what I have said, to expatiate further on the great commercial and political importance to Great Britain in thus being able to communicate with her colonies, and Englishmen richly deserve *kudos* for their enterprise, for nine-tenths of all the vast network of this submarine system has emanated from the banks of the Thames, and the head-quarters of all these large companies are to be found in and around that busy centre of commerce, Old Broad-street.

(TO BE CONTINUED.)

THE FUTURE DEVELOPMENT OF ELECTRICAL APPLIANCES.*

BY PROFESSOR JOHN PERRY, B.E., ASSOC. M.I.C.E.

It had been my intention to introduce this subject to your notice by speaking of the great things physical science has already done for humanity. I assure you that I had arranged a most effective harangue on this subject, touching on the Bacons, and Newton, and Boyle, and Watt, and Faraday, and Joule, and Thomson, showing that it was these men in their laboratories who opened the way for Stephenson and Cooke, Wheatstone, Gramme, Edison, and Graham Bell. I meant to tell you how, in days gone by, a few Birmingham business men subscribed to give their townsman, Priestley, sufficient money to live upon while working at original research; and I felt able to prove so clearly to you that it was for the good of the nation to provide scientific men with large laboratories, and to ensure them freedom from ordinary cares, that in the mere preface to my proper subject I prepared an hour's lecture. Luckily, I remembered that you had all had opportunities of hearing about the benefits you owe to science; and I bethought me that you might even be tired of listening to truisms regarding endowment of research, truisms to members of the Society of Arts, but not so well believed in by the general public, and especially by that section of the general public which sees reason to lean on Mr. Ruskin, in whose nostrils the mere names of Watt and Stephenson are as the savoury odours of the Thames at low water, and attends to the views of Sir John Ellesmere, who hated telegrams more than he disliked our common enemy. Men of this stamp may well think of the future with horror, for there is every sign that applied science is increasing the acceleration of the rate of its development. To such men I would say—put a stop to laboratory work, set your faces against the endowment of research, root up the acorn if you would not in the future be plagued with the oak. The applied science of the future lies invisible and small in the operations of the men who work at pure chemistry and physics. These men do not know what will be the outcome of their labours. They often think that they sympathise with Mr. Ruskin; but you might as well ask a dram-drinker to give up that which his soul loveth, as ask a man who has done real experimental work to give it up. I have often watched Sir William Thomson, to whom every object in nature is continually suggesting new ideas, new experiments, to whom every particle of brass scraped off by a file is a being full of complication, an object of interest and a thing of beauty, and to whom the study of the bending of a bit of brass wire is a joy for ever. Sir William Thomson believes in applied science, but such belief has really nothing to do with the delight which he and every other experimenter has in his work.

Now, electrical science has reached a position from which, on every front, hundreds of enticing paths lead forward into unexplored regions of nature. At every step in advance the laboratory worker sees to right and left of him new and promising lines of research; and he feels that, for the work to be done, the present army of explorers is all too small and weak. But interesting as it might be to prophesy on investigations newly begun, it is rather my purpose to-night to take you upon the well-trodden ground prepared for us by Faraday, and Joule, and Thomson; to show you how, in one or two great lines of the applied science of electricity, certain fixed laws tell us about the future. I shall then speak of a few of the more recent discoveries.

Now, in the first place, you must remember that electricity is to us something that can be measured, although, unfortunately, to the ordinary telegraph operator this is not the case. If you can imagine a mechanical engineer regarding a distance of a few inches as being equal to the distance of a few miles, or even of a few thousand miles, if you can imagine a grocer confounding an ounce of sugar with a ship's-load of the same material, you get a too truthful idea of the vagueness, the general want of definiteness in the notions of nearly all students of this subject until a few years ago; and, I am sorry to say, that much of this vagueness is still to be found, even in modern scientific papers. Perhaps, when electricity is applied to every house in the City of London at a certain price per horse-power, and is used by private individuals for many different purposes, this vagueness will finally disappear. To get exact ideas in any department of physics, we have one firm foundation to build upon, viz., that a certain amount of energy or power of doing work remains always the same, in whatever form it may appear. I have here various sources of electricity—a voltaic cell, a thermopile, a glass-plate machine, a magneto-electric machine, which may be turned by hand, and dynamo-electric machines outside, which I can drive by means of a gas engine, &c. As you know, there are many others. To all these some form of energy is given, and they convert this energy, badly or well, into electric energy. The cell burns zinc, in the thermopile gas is burnt; to the three last machines mechanical energy is given; they all give out electrical energy. Now, how do we know that there is a production of electrical energy? Let us take any one of them (this voltaic cell, for instance). Some form of energy is given out, for you see that I can convert it into heat. [Experiment shown.] Here I take advantage of a property somewhat analogous to mechanical friction.

The thermopile is also generating electricity. To test this I connect its poles to the wire of a galvanometer, and the instantaneous deflection of the needle of the galvanometer tells me about the current. [Experiment shown.] Here is another proof that some kind of energy is traversing the wire connecting these two screws. The two wires are attached to an arrangement at the other end of the room; when I complete the circuits, whether I do it here or there, the bell rings. [Experiment shown.] You see that in this case the heat energy given out by this burning gas is converted partly into electrical energy, in which state it can be transmitted to a considerable distance and there converted into mechanical energy, or into sound, or into any other form of energy. In these and other ways we can detect the existence of the electrical energy coming from all these generators, and measure its amount. Now, Joule's experiments tell us that any generator gives out exactly as much energy as is given to it, but much appears in the form of heat. All these generators get heated, and may be said, therefore, to waste energy. One great object of the inventors of such machines is to give out as much as possible of the energy supplied to them in the shape of electrical energy. You must clearly distinguish between electricity, and electrical energy. A miller does not merely speak of the quantity of water in his mill-dam, he has also to consider the height through which it can fall. A weight of one thousand pounds falling through a distance of one inch, represents the same energy, that is, gives out the same amount of work in falling, as one pound through one thousand inches. A mere statement, then, of the quantity of electricity given out by a machine is insufficient; it is also necessary to state what is the height or difference of potential through which it is falling. The quantity of electricity in a thunder cloud is comparatively small, but the difference of potential through which this quantity passes when discharge occurs is exceedingly great. So is it with the two factors of the electrical energy developed by this glass machine. The quantity of electricity obtainable from this machine is comparatively small, but it is like a small quantity of water at an exceedingly great height, whereas, in all these other machines we have, in the analogy of the miller, a very great quantity of water and a very small difference of level. I put this water analogy before you because you have all more or less exact notions about water, and because, within certain limits, the analogy is a very true one. I have traced it more fully in the wall-sheet. Of this and the other wall-sheets each of you possess printed copies.

* Paper read before the Applied Chemistry and Physics Section of the Society of Arts on March 24th, 1881.

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WALL-SHEET I.

We Want to Use Water.	*We Want to Use Electricity.*
1. Steam pumps burn coal and lift water to a higher level.	1. Generator burns zinc, or uses mechanical power, and lifts electricity to a higher level or potential.
2. Energy available is, amount of water lifted × difference of level.	2. Energy available is, amount of electricity × difference of potential.
3. If we let all the water flow away through channel to lower level without doing work, its energy is all converted into heat because of frictional resistance of pipe or channel.	3. If we let all the electricity flow through a wire from one screw of our generator to the other without doing work, all the electrical energy is converted into heat because of resistance of wire.
4. If we let water work a hoist as well as flow through channels, less water flows than before, less power is wasted in friction.	4. If we let our electricity work a machine as well as flow through wires, less flows than before, less power is wasted through the resistance of the wire.
5. However long and narrow may be the channels, water may be brought from any distance, however great, to give out almost all its original energy to a twist. This requires a great head and small quantity of water.	5. However long and thin the wires may be, electricity may be brought from any distance, however great, to give out almost all its original energy to a machine. This requires a great difference of potentials and a small current.

You will readily understand, then, that for some purposes it is necessary to have our electrical energy in the shape of a small quantity of electricity falling through a great difference of potential, and for other purposes a great quantity of electricity falling through a small difference of potential. When electricity falls through a difference of potential, this difference is called an electromotive force. It would take me too long to tell you why we use two terms to express what seems to be the same thing; but briefly, the term "difference of potential" is analogous with "difference of pressure" or "head" of water, howsoever produced; whereas electromotive force is analogous with the difference of pressure before and behind a slowly moving piston of the pump employed by an unfortunate miller to produce his water supply.

The first object of my lecture is to show you that electricians have very definite ideas on the subjects they are working at; that the measurements, on which their work depends, have exact meanings, and that there is hardly any problem in adding to man's powers which you can set before them to solve, which they may not hope to do with more or less costly apparatus. Everybody knows that the civil engineer is still very far from having reached the limiting lengths or sizes to which large bridges and other structures may be built at a greater or less cost. Everybody is competent to form a roughly correct judgment in such matters, because everybody has more or less notions about sizes, weight, and strength of materials. And in the same way, that you may be able to guess of what the electrician may do in the future, it is necessary that you get fairly correct ideas of electrical magnitudes; and the curious fact is that, seeing how simple it is to arrive at these correct ideas, so few people possess them.

ELECTRICAL MAGNITUDES (SOME RATHER APPROXIMATE).

Resistance of

One yard of copper wire one-eighth of an inch diameter	0·002 ohms.
One mile ordinary iron telegraph wire	10 to 20 ,,
Some of our selenium cells	40 to 1,000,000 ,,
A good telegraph insulator	4,000,000,000,000 ,,

Electromotive force of

A pair of copper-iron junctions at a difference of temperature of 1° Fahr.	= 0·000,0 volt.
Contact of zinc and copper	= 0·75 ,,
One Daniell's cell	= 1·1 ,,
Mr. Latimer Clark's standard cell	= 1·45 ,,
One of Mr. De la Rue's batteries	= 11,000 ,,

Lightning flashes probably many millions of volts.

Current measured by us in some experiments:—

Using electrometer	= almost infinitely small currents.
Using delicate galvanometer	= 0·00,000,000,040 weber.
Current received from Atlantic cable, when 25 words per minute are being sent	= 0·000,001 ,,
Current in ordinary land telegraph lines	= 0·003 ,,
Current from dynamo machine	= 5 to 100 ,,

In any circuit, *current* in webers = *electromotive force* in volts ÷ *resistance* in ohms.

RATE OF PRODUCTION OF HEAT, CALCULATED IN THE SHAPE OF HORSE-POWER.

In the whole of a circuit = *current* in webers × *electromotive force* in volts ÷ 746.

In any part of circuit = *current* in webers × *difference of potential* at the two ends of the part of the circuit in question ÷ 746.

Or, = square of current in webers × resistance of the part in ohms ÷ 746.

If there are a number of generators of electricity in a circuit, whose electromotive forces in volt are—E_1, E_2, &c., and if there are also opposing electromotive forces, F_1, F_2, &c., volts, and if C is the current in webers, R the whole resistance of the current in ohms, P the total horse-power taken at the generators, Q the total horse-power converted into some other form of energy, and given out at the places where there are opposing electromotive forces, H the total horse-power wasted in heat, because of resistance, then

$$C = \frac{(E_1 + E_2 + \&c.) - (F_1 + F_2 + \&c.)}{R}$$

$$P = \frac{C}{746}(E_1 + E_2 + \&c.);\quad Q = \frac{C}{746}(F_1 + F_2 + \&c.);$$

$$H = \frac{C^2 R}{746}.$$

The lifting-power of an electro-magnet of given volume is proportional to the heat generated against resistance in the wire of the magnet.

The future of many electrical appliances depends on how general is the public comprehension of the lessons taught by these wall-sheets. If a few capitalists in London would only spend a day or two in learning thoroughly what these mean, I am quite sure that electrical appliances of a very distant future would date from a few months hence.

It is not necessary for me to tell you now that electrical energy may be produced; nor need I waste time in speaking of how it may be transmitted to a distance by means of insulated metal wires. A more important fact is that, when electricity is flowing in a wire, I can transform part of its energy into other shapes. For instance, here is an iron wire of 2 ohms resistance. Suppose this to be in a cold room, and I turn on the electricity tap. An electric machine, driven outside by a gas engine, is here my source of energy. This wire is now getting a supply of electrical energy, and is converting it into heat. Mr. Andrews tells me that there is now a current of 20 webers flowing through the wire, and hence the wire is giving out more than one horse-power in the shape of heat. Some of you may have thought that very little heat can be given out by such a wire; but these are the exact figures, and you can all see that they represent a pretty large supply. When the current has been flowing for a short time, the neighbourhood of this wire will be found unpleasantly warm, and I can assure you that the use of this instrument for certain measuring purposes is very disagreeable in the summer time. It is hardly necessary to say that a wire, through which a current is flowing, may be made to give out its heat for a great variety of purposes. The temperature may be pretty much what we please. Thus, I turn the tap, and this wire gives off very intense heat. [Experiment shown.] I turn another tap, and a spiral in this vessel of water will presently make it boil. [Experiment shown.] I turn another tap, and the strip through which the current passes becomes white hot, and we call it, vaguely, an electric light. [Experiment shown.] This is the incandescent light which has been proposed for use in ordinary houses. It is confessedly not economical, but it is very convenient for chamber use. I now turn another tap and you see my own lamp, which is of an exceedingly simple form, there being only one electro-magnet to perform the regulation and separation work. Its construction is shown in a diagram on the wall. You see, then, that we can convert electrical energy into heat and light; but the question is, how much of a result do we get for the power expended?

Professor Ayrton and his students measure at Cowper-street, 1st, how much gas is being used by his gas engine; 2nd, how much horse-power is being actually given to his electric machine; 3rd, how much current is produced through external circuits by his machine; 4th, the resistance of these circuits. He can now calculate exactly how much horse-power is expended in any part of these circuits, and also how much light is annually given out by an electric lamp.

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SLIP

POST OFFICE TELEGRAPHS.—The revenue for the past year ended 31st March amounted to £1,600,000.

THE ELECTRIC LIGHT IN INDIA.—The electric light will shortly be tried at the Allahabad Railway Station.

GLASGOW MECHANICS INSTITUTION.—We hear that this institution is to be called henceforth the "College of Science and Arts."

THE TELEPHONE AT MELBOURNE.—A Reuter's telegram says that a telephone exchange has been successfully established in this city.

EDINBURGH PHILOSOPHICAL INSTITUTION.—Mr. Gladstone has been unanimously elected president of this association in the room of Mr. Carlyle.

THE TELEPHONE IN PORTUGAL.—A concession has been requested for the establishment of telephone lines between Lisbon, Oporto, and other towns.

UNDERGROUND WIRES IN FRANCE.—The underground system, which we stated in a recent note as extending from Paris to Nancy, is about to be continued from the latter place to Toul.

ELECTRIC LIGHT IN ITALY.—One of the large cafés of Milan has been lighted for some weeks past by the Siemens light. The same firm have established their system at the Florence railway station.

MR. W. H. PREECE.—We are glad to be able to announce that Mr. W. H. Preece, M.I.C.E., Electrician of the Post Office Telegraphs Department, has been elected a Fellow of the Royal Society.

THE TELEPHONE AT HAVRE AND ROUEN.—La Societé Générale des Telephones is establishing telephonic exchanges in these cities. The number of subscribers is said to be considerable.

GERMAN UNION TELEGRAPH AND TRUST COMPANY.—The tenth ordinary general meeting of shareholders of this Company will be held at 66, Old Broad-street, E.C., on Tuesday, the 12th April, at 12 noon.

ADDITIONAL TELEGRAPH LINES FOR ABERDEEN.—The Aberdeen Town Council have resolved to memoralise the Postmaster-General to erect an additional and continuous telegraph wire from Aberdeen to Wick.

TELEPHONE SHARES.—The market report of the *Daily Telegraph* for Wednesday says:—"United Telephone shares were in strong request at 8¼ on reports of an amicable arrangement with a rival undertaking."

PERSONAL.—Mr. E. Bishop, commander of the telegraph steamer "Patrick Stewart," has, says the *Homeward Mail*, been appointed Assessor of the Court of Survey at Kurrachee, under the Indian Merchant Shipping Act.

ELECTRIC LIGHT AT THE POST OFFICE.—The Brockie system is to be tried in the telegraph instrument room at the Central Office, and also in the letter-sorting department. In the newspaper-sorting department the Brush system is to be tried.

CHINESE TELEGRAPHY.—An arrangement has, we hear, been signed at Tientsin between the agent of the Great Northern Telegraph Company and the Chinese authorities for that company to work the land lines between Tientsin and Shanghai which they have contracted to erect.

THE ELECTRIC RAILWAY AT BERLIN.—A telegram from Berlin, dated Wednesday night, says:—"The trial trip on the Electric Railway from Lichterfelde to the Central Cadet Institution was successfully performed this morning. Messrs Siemens and Halske have accomplished a complete triumph."

GLOBE TELEGRAPH AND TRUST COMPANY.—This Company give notice that interim dividends for the quarter ending 18th April, 1881, of three shillings per share on preference shares, and two shillings and sixpence per share on ordinary shares, free of income-tax, will be paid after the 20th April.

ELECTRIC LIGHTS AT LIVERPOOL.—The British Electric Light Company are to light about 2½ miles of the principal streets of Liverpool with sixty lamps, the lighting to commence on the 1st May. Brockie lamps and Gramme machines will be used, as already working at Cannon-street and elsewhere.

FALL OF A METEORITE.—A meteoric stone fell near Northallerton (Yorks) on the 14th March last; and was exhumed by some labourers, being quite warm when taken from the ground. Its fall was accompanied by a loud rumbling noise, which was heard at some distance. The sky was quite clear, and the air cold.

PRICES.—The prices as quoted are:—For gutta percha per lb. (genuine), 4d. to 3s. 3d., reboiled 3d. to 1s. 3d. For india rubber:—Para (fine) 3s. 6½d., negrohead 2s. 5d., Central American 1s. 11d. to 2s. 6d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d.

EDISON ELECTRIC LIGHT COMPANY.—A New York telegram of Wednesday last says:—"The Mayor has vetoed the ordinance permitting the Edison Electric Illuminating Company to lay tubes in the streets, on the ground that no adequate provision is made for a suitable return to the city treasury for a valuable privilege."

CUBA SUBMARINE COMPANY.—The number of messages passing over the lines of this company during the month of March was 3,205, estimated to produce £3,100, as against 3,294 messages, producing £3,586 in the corresponding month of last year. The traffic receipts for the month of January, estimated at £2,800, realised £2,527.

THE TELEGRAPH CLERKS' GRIEVANCES.—It is reported that one hundred and fifty members of Parliament have promised to support a motion, which will be made when the Post Office estimates come before the House of Commons, relative to the treatment which has been officially accorded to the telegraph *employés* by the Postmaster-General.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—Invitations have been issued by the President and Council of this Society for a *conversazione* in honour of Professor Helmholtz, to be held on Monday evening, April 11th, at 9 o'clock, at University College, Gower-street. The library and entrance hall will be illuminated by the electric light.

EARTHQUAKE AT CHIO.—During the panic caused by the recent disastrous earthquake at Chio, in which 3,000 persons are reported to have lost their lives, the Eastern Company's Telegraph Station was broken open and pillaged. Later intelligence says:—The Eastern Company's office is nearly destroyed, and the clerks are working temporarily from the landing place of the cable.

ELECTRIC LIGHT IN GLASGOW.—The Committee of the United Evangelistic Hall, in Glasgow, have substituted the electric for the lime light hitherto used at their weekly lantern exhibition, the effect being spoken of as such that has never been seen before. The steam power was furnished

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by Messrs. Butters Brothers, whilst the electric light apparatus was supplied by Messrs. Anderson and Munro.

THE UNITED TELEPHONE COMPANY.—We are informed that the difficulties which have hitherto prevented the United Telephone Company extending their exchange system over the whole metropolis, owing to the Post Office monopoly, have now been removed, and the Post Office has granted a licence to the Company to erect telephone exchanges, they paying the Post Office an annual royalty on the subscriptions received.

GOWER-BELL TELEPHONES AT SWANSEA.—We are informed that Mr. Legg, engineer to the Swansea Telephone Exchange Company, has substituted Gower-Bell telephones for the A B C instruments used by the police authorities. The new instruments give great satisfaction to the police. They will be on trial for one month, and if a favourable report be given, a complete telephonic and electric alarm system for the fire brigade will be adopted.

MILITARY SIGNALLING.—With reference to a recent paragraph in this journal relating to the usefulness of telegraphists serving in a north country corps of volunteers for army signalling purposes, we are informed that the Post Office Rifles in London have distinguished themselves on more than one occasion by a speed of flag signalling quite unprecedented, and that the "regulars" cannot touch them in this particular. The Morse alphabet is employed.

ELECTRIC LIGHT FOR SUDBURY.—Is Sudbury to have the honour of introducing the electric light to Suffolk, as a means of lighting public streets? At a recent meeting of the Town Council a committee reported that, after making careful inquiry, they found that the lighting of the streets of the town by electricity would cost £260, as against £360 for gas. As a consequence of this the gas company, who at present charge 4s. 9d. per 1,000ft., are thinking of reducing the price to 4s. 1d.

ELECTRIC LIGHT ON THE GREENOCK STEAMBOAT QUAY.—Operations connected with introducing the electric light on the Greenock Steamboat Quay and to several of the adjacent harbours are now proceeding rapidly, and it was expected that the light would be shown for the first time on Tuesday, the 5th April. The stationary engine has been erected under the pillar clock fronting the Custom House, and poles, upon which lamps are to be fixed, are being erected on other parts of the quay.

SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—The next meeting of this society will take place on Thursday, the 14th instant. As we have already announced, a paper will be read by Mr. Lane Fox on "The Application of Electricicy to Lighting and Heating for Domestic and other Purposes;" in addition to which, Professors Perry and Ayrton will read papers on "A Portable Absolute Galvanometer for Strong Currents" and on "A New Transmission Dynamometer."

ACCIDENTS BY LIGHTNING.—A correspondent of *La Nature*, writing from Cordova, Argentine Republic, speaks of a violent thunderstorm as having occurred on 31st January last, in which four persons and two horses were struck dead, and several other persons and one horse badly hurt, by one lightning flash. The bodies of the dead showed the track of the lightning in a kind of clear reddish streak. They were struck on the head or the back. It was remarked that the traces of the fluid always ended at the heart.

INTERCEPTING TELEGRAMS.—The reverend gentlemen whom we referred to in a previous note as having been summoned for retaining telegrams which should have been delivered to the superintendent of police at Derby appeared for trial on Tuesday last. After hearing the case, the jury gave a verdict of not guilty. There seems to be a considerable amount of mystery about the whole thing, and it is almost needless to say that one of the weaker sex was, if not at the bottom of it, at all events concerned in it.

THE SWAN LIGHT IN MINES.—With reference to our last week's note which announced the introduction of this lamp into Mr. Watson's colliery at Earnock, we hear that it is intended to erect the dynamo-electric machines in the engine-house connected with the Ginbal fan at the colliery. From the engine-house the electric cables will be led down the nearest pit shaft into the workings. The preliminary operations attending the introduction of the light will occupy nearly a couple of months. Mr. Andrew Jamieson is the electrician in charge of the work.

FRENCH PHYSICAL SOCIETY.—At the last meeting of this society, on 4th March, Dr. Boudet exhibited a very sensitive microphone, the principal characteristic of which is an oscillating carbon, regulated by a small paper spring. He showed that many of the results obtained by the microphone can be effected with a simple apparatus, formed of an ordinary stethoscope, furnished with a thin vibrating plate of hard india rubber, with explorer button, and two india rubber tubes leading to the ears. Dr. Boudet also presented a multiplier audiphone on the same principle.

SILENT ELECTRIC DISCHARGE.—MM. Hautefeuille and Chappuis have made experiments on the appearance presented by the luminous brushes produced in silicon fluoride, nitrogen, and other gases when they are placed in the annular space between the concentric tubes of A. Thenard's alternating discharge apparatus. The appearance is most brilliant in silicon fluoride at pressures above 5 mm. In all gases, it only appears at certain pressures, passing with increased pressure into the electric spark, and with decreased pressure into the uniform glow of a vacuum tube.

ELECTRIC LIGHT FOR THE WEST END WANTED.—"What do the inhabitants of Billiter-street want with the electric light?" says the *Citizen*. "The amount of business that goes on there after sundown is not so large as to require an extra amount of illumination. When the City has led the way it is hoped that some of the streets in the West End will have a little pure light granted to them. The proceedings at night in all of them are not such as would stand such a light as may now be found in the City. The Brush electric light might brush out a few dirty corners!"

"L'ELECTRICIEN."—The appearance of this journal, which was announced for the 15th of last month, is postponed until the 15th of April. The editing committee will include MM. Mercadier, C. M. Gariel, A. Niaudet, Dr. de Cyon, and Gaston Tissandier, with M. E. Hospitalier as secretary. It is to be a bi-weekly paper of 48 pages. Although always glad to welcome a contemporary in the great cause of electrical science, we greatly regret that our French friends did not adopt a title less like our own. No doubt imitation is the sincerest flattery, but it has its inconveniences nevertheless.

ELECTRIC LIGHT AT BERLIN.—*La Lumière Electrique* says that the Anhalt Railway Company, who have employed the electric light at their terminus at Berlin for a year past, have been so pleased with it that they have determined to increase the number of the lights. The vestibule entrance to the station, which has hitherto been lighted with gas, and whose space is about 3,909 cubic metres, by 16 metres high, is to be lighted by one electric lamp. During the year in which the electric light has been burning there has been no

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hitch of any sort or kind, and the dynamo machines have worked splendidly.

THE WIRE TRADE.—The Birmingham correspondent of *The Times* makes the following remarks:—"Iron wire trade practically dead, so far as Birmingham makers are concerned. A few firms contrive to do a certain limited business by importing and drawing down Westphalian rod, but in the finer gauges the foreigner is able to undersell them by as much as £3 per ton; and as freights are all in his favour, and Rheinish wire can be delivered in the Thames for much less than Birmingham wire, the export trade has virtually passed out of our hands." Ichabod! The exclamation is ours, not *The Times* correspondent's.

SOUTH AFRICA.—The Eastern and South African Telegraph Company's station at Lourenço Marques (Delagoa Bay) has been completed. It consists of a fine double-storied house, with large verandah, and is surrounded by a considerable piece of land acquired by the company with the object of preventing native villages or any inconvenient structure being erected in too close proximity to the premises. The company hope that instead of being regarded as an unhealthy spot the station at Lourenço Marques will in future be considered a healthy and agreeable place, as the office and quarters have been built upon an elevated point jutting out into the sea, and the directors have done everything in their power for the comfort and welfare of the staff.

A DIFFERENCE OF OPINION.—The *Gas Journal*, in a note on the Electric light in the City, expresses its opinion that "the honours fall to the Anglo-American Company (Brush system) for the beauty and steadiness of their light." A correspondent, however, says, on the contrary, that those words express his sentiments with regard to the Siemens light, and we are inclined to agree with him. The Brush light is very good, but we think the Siemens better. The *Gas Journal* goes on to say: "If we were as fond of prophesying as some of our electrician friends, we might be more fully disposed than we really are to indulge in anticipations of the end." Exactly. Like Micawber, we suppose our contemporary will wait for something to turn up.

THE ELECTRIC LIGHT AT THE CANNON-STREET STATION.—The electric light was used for the first time at the Cannon-street Station on the evening of the 31st ult. The arrangements there consist of Gramme machines and Brockie arc lamps, and the work has been carried out by the British Electric Light Company. Eight powerful lights of 6,000 candles each are suspended from the roof of the station at a height of about forty feet from the platforms, and there are two lights outside the station. There are two circuits for the ten lights, five upon each, and the current for each circuit is produced by one of the large new type of Gramme machines recently introduced by the British Electric Light Company, which work a number of arc lights in series.

THE PROGRESS OF ELECTRIC LIGHTING IN THE METROPOLIS.—In addition to the Thames Embankment, which has been lighted by electricity for many months past, between Blackfriars and Westminster, we have now a continuous line of lamps extending from the first named bridge to the south side of London Bridge by way of Fleet-street, Cheapside, and King William-street. The light in the Clock Tower of the Houses of Parliament overlooks them all. Liverpool-street and Paddington Stations have been lighted by electricity for some time past; Charing Cross has followed suit more recently, and now the Cannon-street Station swells the number. It has been partially in use at Aldersgate-street Station for nearly twelve months past. Some of the District railway stations have also availed themselves of the proximity of the Embankment systems, and an experiment is in full operation at the Bricklayer's Arms Depôt, where the value of the light in a large goods shed will be fully tested.

CRICKET: TOWN V. TELEGRAPH.—We extract the following account of a spirited cricket match between the Eastern Telegraph Company's staff at Alexandria and the Town from the *Egyptian Gazette*:—"The Town having won the toss, decided to go to the wickets first. Some hard hitting was shown by Messrs. N. J. Sinnott and F. Wakeham, and not until the total had reached 79 were the whole eleven disposed of. The Telegraph made a bad start by losing three good wickets for 5 runs, but chiefly through the good batting of Mr. J. D Wallich the score eventually reached 74. The Town in their second venture made only 37, the effective bowling of Mr. Weeks being the cause of this rather poor total. The Telegraph sent in Messrs. Anstice and J. D. Wallich to knock off the necessary runs, viz., 43, which they did without being separated, Mr. J. D. Wallich carrying his bat for 25 and Mr. Anstice for 15, thus turning what appeared to be a certain defeat for the Telegraph in the early part of the game into an easy victory by ten wickets."

INTERNATIONAL ELECTRICAL EXHIBITION.—The French Government recently tendered to the United States an invitation to be represented in an International Congress of Electricians, to be held at Paris on 15th September next, and also to send an American Commission to the exhibition to be opened on August 1. President Hayes on January 10 recommended Congress to provide for proper representation, both at the Congress and in the exhibition, but the suggestion failed of action before the close of the Session. It is announced that the Secretary of State is considering the feasibility of organising a volunteer commission to represent the United States, and to that end he has applied for and obtained an extension of the time fixed for receiving applications from American inventors until the 15th May. The final date for admission of exhibits of other countries has been prolonged to April 15. We learn that the duties of Commissioner General of the United States section will be undertaken by the Hon. Levi P. Morton, the new American Minister to France. The United States Consul General at Paris will act as Executive Commissioner. Three honorary Commissioners will also act, of whom the President has only yet appointed one, Col. Goisraud, resident in London.

TEMPERATURE OF THE ELECTRIC LIGHT.—In 1860 M. Ed. Becquerel showed that the temperature of the luminous arc produced by a battery of eighty Bunsen cells reached from 2·070 to 2·100 deg. Centigrade, and he stated that the brilliancy of the light, as well as the radiant heat, increased proportionally, a law already established by MM. Dulong and Petit. Other experimenters have found that this law is not true at high temperatures. M. Rosetti has endeavoured to clear up this question by proceeding in a different manner in his experiments, and by projecting the heat rays emanating from a given surface of the carbon electrodes on a thermo-electric battery, joined up to an astatic mirror galvanometer. According to numerous experiments made with 160 Bunsen cells and a Duboscq lamp, the temperature of the positive carbon appeared to vary between 2·400 deg. and 3·900 deg. Centigrade. The smaller the radiant surface, the higher the temperature, it being understood that the extreme points of the carbons were included in the radiant surface. The temperature of the negative electrode varied between 2·138 deg. and 2·530 deg. Centigrade, and consequently the temperature of the extreme points of the electrodes was not less than 2·500 deg. to 3·900 deg. Centigrade. In a Regnier lamp connected with eight or ten Bunsen cells, the

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temperature of the positive carbon reached 2·406 deg. to 2·734 deg. Centigrade.—*La Lumière Electrique.*

ELECTRICITY IN THE WRONG PLACE.—The Albany *Journal* records an incident that exhibits this good servant in the character of a bad master. In one corner of Weed, Parsons and Co's printing establishment stands the machine that furnishes the electric light for an adjacent store, the power coming from the engine of Weed, Parsons and Co. One feature of the machine is the armature, a wheel containing coils of insulated wire through which the electricity flows in powerful currents when the apparatus is in operation. This armature revolves with terrific velocity, and constitutes a powerful magnet. On the day mentioned, a young man came in and ground a pair of large scissors at an emery wheel near the generator. Turning to go out past the machine, he carried the scissors carelessly in his hand, when they were immediately drawn into the armature, and were soon revolving with it at frightful speed. The young man got out of the way as quickly as possible and was unhurt. For a few minutes the machine presented a very startling spectacle. The whirling scissors, twisted and broken, but still adhering to the revolving armature, began to cut the wires, and thus broke the electric current, which escaped in streams from the fractured ends of the wires, and in a moment or two that portion of the room was literally filled to the ceiling with whirling lightning. No one dared to approach the machinery for some little time, but the belt was finally thrown off, and the dangerous show was at an end.

RADIOPHONY.—FURTHER EXPERIMENTS BY M. MERCADIER.—Continuing his researches, M. Mercadier has used small glass tubes connected by an india rubber tube with a cornet, as receivers of the intermittent radiations. A portion of the interior of these tubes may either be smoked, or sheets of smoked tinsel, mica, aluminium, zinc, &c., may be placed in them. When the radiations are made to fall on the glass only, the sounds produced are very weak; when they fall on the smoked portion, or on the different sheets, they become loud. The nature of the substance which is smoked does not in the least modify their intensity. By means of these tubes M. Mercadier has studied the effects of liquids. Projected on the part of the tube containing the liquid (water, ether, ammoniac) the radiation produced no effect; projected above, it gives rise to a weak sound, which increases in volume according as, by heating the liquid, the internal atmosphere is saturated with vapour. The receiving tubes can be connected in an analogous manner to battery cells, either in series or tension, or in surface or quantity. They thus form thermophonic batteries, which are capable, with a sufficient length of cells or of the tubes which unite them, of producing a considerable augmentation in the sounds. By taking long tubes, furnished at one of their ends with a small piece of smoked tinsel, true sonorous tubes vibrating longitudinally after the manner of ordinary tubes are obtained, and with these it is possible to repeat every experiment made with the others, the manner of the vibration alone differing.

DYNAMO-ELECTRIC MACHINES AND COPPER MINING.—These machines are now employed at the Royal Mines of Oker, where they have quite superseded the old method of treating the water containing copper ore by electrolytic deposition. The machines to be of any use must have a small resistance, and must be of special construction. The wire of the inducers is replaced by bars of copper 13 centimetres square in section, insulated one from another and from the rest of the machine by asbestos. A similar arrangement, but with bars of smaller section, is made use of in the armature. The internal resistance of these machines is ·0007 ohm, the E. M. F. about three volts, and with the external resistance of the deposition baths the intensity of the current is about 800 webers. These figures have reference to copper solutions containing not more than ½ per cent. of impurities. The more impure the solution the greater the electric polarisation which takes place in the baths, and the more work it is necessary to obtain to overcome this polarisation, which is at its maximum when gas is disengaged—that is, when water is decomposed. In practice it is usual in machines of small resistance, when the electrolytic polarisation should be small, to join up the inducers and the armature in tension; when, on the other hand, the polarisation should be strong, they are joined up in quantity. The old method was to place iron bars in the baths, into which the water containing copper in solution was made to pass. A quantity of iron equal to the copper contained in the liquids was dissolved, and the copper precipitated in the form of a powder. Sometimes the deposition was helped on by means of a battery.—*Electrotechnische Zeitschrift.*

PROFESSOR HELMHOLTZ AT THE ROYAL INSTITUTION.—The Faraday lecture was delivered under the auspices of the Chemical Society, on Tuesday evening last, in the theatre of the Royal Institution, by Professor Helmholtz. A few words as to who Professor Helmholtz is, and what he has accomplished, may not be out of place here:—Herrman Ludwig Ferdinand Helmholtz, one of the most distinguished natural philosophers and physiologists of the present century, was born at Potsdam, August 31st, 1821. After obtaining his degrees as Doctor of Medicine he served for a time as a military surgeon, and became in 1849 Extraordinary Professor, and in 1852 Ordinary Professor of Physiology in the University of Koningsberg; in 1855 he became Professor of Physiology in the University of Bonn, and in 1858 Professor of Physiology in that of Heidelberg. Between 1847 and 1854 he published a most remarkable and original series of papers on the relation amongst the physical forces in which he laid the foundation of that branch of the general theory of physical energy which shows how electricity and magnetism, as well as heat and motion, can be brought under that theory. In 1852 he contrived a new method of experimenting on the combination of the colours of the spectrum by which all the possible combinations of those colours in pairs were exhibited and various unexpected facts and laws were discovered. He has also investigated experimentally the velocity with which sensation and volition are transmitted by the nerves of different animals, the laws of the sensibility of the retina, the development of heat and waste of substance by muscular action, and the mode of vibration of the strings of violins and other musical instruments, making in each case most interesting and valuable additions to our knowledge. The whole of the researches of Professor Helmholtz are marked by rare exactness and care in the observations of details, combined with still more rare comprehensiveness and soundness of generalisation, as is evidenced in his "Popular Lectures on Scientific Subjects," which, thanks to Professor Tyndall, have been admirably translated by Dr. Atkinson; by his great work on "The Sensation of Tone as a Physiological Basis for the Theory of Music," translated by Mr. Alexander J. Ellis, F.R.C., and by his essay entitled "Die Erhathung der Krafte" [The Conservation of Energy], communicated to the Physical Society of Berlin in 1847, and which brought forth the remark of Dr. Du Bois Raymond "that it was the production of the first head in Europe since the death of Jacobi."

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THE SELENIUM RECEIVER.

The researches of M. Mercadier in Paris on the action of the selenium cell and other bodies under a varying beam of light have done much to prove that while the sonorous effect of the intermittent beam on discs of metal, &c., as discovered by Professor Graham Bell, is due to the impact of the heat rays in the beam, the action of the selenium cell is almost wholly due to the impact of luminous rays. By sending the coloured rays of the spectrum through holes in a revolving screen, and concentrating them on a selenium cell, M. Mercadier has demonstrated that the changes of resistance in receivers of selenium are produced by the rays lying between the blue verge of the indigo on the one hand, and a little beyond the extreme red on the other. The indigo, ultra-violet, and violet rays are without influence, at least on the receivers he employed. The light used was sometimes oxy-hydrogen, sometimes electric, sometimes solar, but the general results always agreed, and the maximum effect was caused by the yellow rays. This important result agrees with those of Professor Adams and other English experimenters.

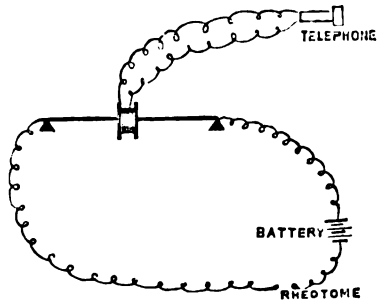
M. Mercadier has also devised a new form of selenium receiver, which is worthy of note. Two ribbons of brass, each 1-10th millimetre thick, 1 centimetre broad, and from 1 to 4 or 5 metres long, are taken and separated by ribbons of parchment paper about 15 millimetres thick. These are wound on a spiral as close as possible, and held tight by screw-clamps. The surface is then polished, and the apparatus heated in a sand bath, or on a copper plate held over a Bunsen burner, till it attains the temperature at which selenium begins to melt. A pencil of selenium is then moved over the surface, and a thin coating of it spread between the brass edges. The surfaces can be preserved by covering them with mica or a coat of gum-lac. The resistance can be made 8,000, 10,000, or 200,000 ohms, without impairing their good action; and hence it is possible to place a number of these receivers in the same circuit either in series or in multiple arc so as to reduce the resistance to a few hundred ohms and permit of a multiplied effect. With one of these receivers of 7 square centimetres only, the oxyhydrogen light gives in a Gower telephone of 235 ohms resistance, furnished with its acoustic tube, sounds which can be heard at 2 or 3 metres distance.

PERMANENT MOLECULAR TORSION OF CONDUCTING WIRES PRODUCED BY THE PASSAGE OF AN ELECTRIC CURRENT.*

BY PROFESSOR D. E. HUGHES, F.R.S.

In a Paper on "Molecular Electro-Magnetic Induction" presented to the Royal Society March 7, 1881, I gave a description of the induction currents produced by the torsion of an iron wire, and the method by which they are rendered evident. The electro-magnetic induction balance there described is so remarkably sensitive to the slightest internal strain in anywise submitted to it that I at once perceived that the instrument could not only determine any mechanical strain such as torsion or longitudinal stress, but that it might indicate the nature and cause of internal strains. Upon putting the question to it, does the passage of electricity through a wire produce a change in its structure? the answer came, it does, and that to a very considerable extent; for an iron wire adjusted to perfect zero, and which would remain free from any strain for days, becomes instantaneously changed by the first passage of a current from a single cell of Daniell's battery; the wire has now a permanent twist in a direction coinciding with that of the current, which can be brought again to zero by mechanically untwisting the wire, or undoing that which the passage of electricity has caused. Before describing the new phenomenon, I will state that the only modification required in the apparatus is a switch or key by means of which the telephone upon the wire circuit is thrown out of this circuit, and the current from a separate battery of two bichromate cells passed through the wire alone, at the same time care being taken that no current passes through the coil, but that its circuit should remain open during the passage of the electric current through the wire under observation. An extra switch on this circuit provides for this. The reason for not allowing two currents to react upon each other is to avoid errors of observation, which may be due to this cause alone. When, however, we take an observation, the battery is upon the coil and the telephone upon the wire alone. An experiment thus consists of two operations. First, all external communications interrupted, and an electric current passed through the wire; and, second, the electric current taken off the wire, and all ordinary communications restored. As this is done rapidly by means of the switches, very quick observations can be made, or if desired the effects of both currents can be observed at the same instant.

Now, if I place upon the stress bridge a soft iron wire ½ millim. diameter, 25 centims. long, I find, if no previous strain existed in the wire, a perfect zero, and I can make it so either by turning it slightly backwards or forwards, or by heating the wire to a red heat. If I now give a torsion of this wire I find that its maximum value is 40 deg. torsion, and that this torsion represents or produces electric currents whose value in sonometric degrees is 50; each degree of torsion up to 40 produces a regular increase, so that once knowing the value of any wire, we can predict from any sonometric readings the value in torsion, or the amount of torsion in the opposite direction it would require to produce a perfect zero.



If now I place this wire at zero, and thus knowing that it is entirely free from strain, I pass an electric current through it, I find that this wire is no longer free from strain, that it now gives out induction currents of the value of 40, and although there is no longer any battery current passing through this wire, that the strain is permanent, the outside coil neither increasing nor diminishing; the internal strain it has received by the passage of an electric current through the wire. Upon giving a torsion to the wire in one direction, I find the inductive force increase from 40 to 90, but in the other direction it is brought to zero, and the amount of torsion, some 35 deg., required to bring the wire again to zero represents exactly the twist or strain that had been produced instantaneously by the passage of an electric current. If I repeat the experiment, but reverse the battery current sent through the wire, I find an opposite twist of exactly the same value as previously, and that it now requires an opposite torsion to again bring the wire to zero. It is not necessary, however, to put on an equal opposite torsion on wire to bring the currents to zero, for, as I have shown in my late paper, the sonometer not only allows us to measure the force and indicate its direction, but allows us to oppose an equal electric current of opposite name, thus producing an electrical zero in place of the mechanical one produced by torsion.

Evidently here there has been a sudden change in the structure of the wire, and it is a twist which we can both measure and reproduce. The question at once becomes, has a molar twist been given to the wire such as would be detected by the arm or free end of the wire, or a molecular change leaving no trace upon its external form of what has passed?

It will be found that, notwithstanding that it requires some 40 deg. of torsion to annul the effects of a passage of an electric current, no visible movement nor any tendency of the free end to turn in the direction of the twist it has received can be observed. I believe, however, to have noticed a slight tremor or movement of half a degree, but as I could not always reproduce it, and as it is so slight compared with the 40 deg. of internal twist, I have not taken it into account, for if the wire is firmly fastened at both ends, no molar torsion being possible, except an elastic one, which would instantly spring back to zero, the current on passing produces its full effects of twist and it is permanent. Thus, the molecules have in some extraordinary way rearranged themselves into a permanent twist, without the slightest external indication of so great a change having taken place. An equally remarkable change takes place in aid of, or against (according to direction of current) an elastic permanent strain. Thus, if I first put the wire under 40 deg. right-handed permanent torsion, I find its value to be 50. Now, passing the positive of battery through its free end, and negative to fixed end, the induction currents rise at once in value to 90; if now, the negative is momentarily passed through the free end and positive to fixed end the induced currents at once fall to 10, and these effects remain, for on taking off the elastic torsion the wire no

* A Paper presented to the Royal Society.

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longer comes to zero, but has the full twist value produced by the current.

Tempered steel gave only one or two degrees against 50 for soft iron, but supposing this might be due to its molecular rigidity, I carefully brought the wire to zero, and then observed the first contact only. I found then that the first contact gave a value of 40, but the second and following only one or two. By bringing the wire back to zero by a momentary touch with a magnet, a continued force of 40, or if constant reversals were used instead of a simple contact, there was constant proof of a similar great molecular change by the passage of a current in steel as well as iron.

I can find no trace of the reaction of the wire upon the magnetism of the earth, as in all positions the same degree of force was obtained, if great care is taken that the wire is absolutely free from longitudinal magnetism; there is, however, a slight reaction upon its own return wire if brought within 1 centim. distance of the wire, and this reduces the twist some 10 deg. The maximum effects are obtained when the return wire is not nearer than 25 centims.; thus, the action is not one produced by a reaction, but by direct action upon its internal structure.

Copper and silver wires so far show no trace of the action. I believe, however, that a similar strain takes place in all conductors, and I have obtained indirectly indications of this fact. In order, however, to verify this, would require a different method of observation from the one I have described, and I have not yet perfected the apparatus required.

It seemed probable that if I approached a strong permanent magnet to the wire, I should perceive a twist similar to that produced by the passage of a current; but no such effects were observed. A wire at zero of strain could not be twisted by strongly magnetising it, either longitudinally or transversely, but it has a most remarkable effect of instantly bringing to zero a strain produced by the current, and, no matter which pole, the effect was the same. Thus, a strain of 50 deg., which remains a constant, instantly disappears upon the production of longitudinal magnetism, and I have found this method of reducing an iron wire to zero of strain far more effective than any other method yet tried, such as vibrations, heat, twisting, &c.

It will be seen from this that the molecular arrangement set up by magnetism is very different from that produced by the passage of an electric current. It evidently has a structure of its own, else it would not have instantly destroyed the spiral strain left by the passage of electricity if it had not taken up a new form; as rendered evident in the longitudinal magnetism, which we could at once perceive on the wire. This question, however, belongs to a separate investigation, and I hope the apparatus will aid me later in throwing some new light upon this subject.

Another method of reducing the wire to zero, after the passage of a current, is to keep the wire in a constant state of vibration. It requires in time about one minute to bring it to zero, but if, on the contrary, I set the wire vibrating during the passage of the current, the permanent twist becomes greater and more difficult to reduce to zero.

If a wire which has internal strains is heated to redness, these strains almost entirely disappear, and I can thus reduce by heat a strain which a current had produced; but heat, whilst allowing of greater freedom and motion of its molecules, does not prevent an internal strain being set up, for whilst heat can reduce the wire to zero, after the passage of the current, the effects are increased. If, during the time that the wire is at a red heat, the current is passed in the same time, and at the same instant we take off the current and the external heat, the wire when cold will be found to have a higher degree of strain than previously possible with the wire when cold.

We have seen that both mechanical vibrations and heat can reduce the wire to a zero, but its action is very slow, several minutes being required; but the action of electricity in producing a permanent twist is exceedingly quick. I have found that a single contact, whose duration was not more than 0·01 of a second, was equal to that of a prolonged contact of several minutes, and magnetism was equally as quick in reducing this strain to zero. And it is the more remarkable when we consider the very great mechanical force required by torsion of the wire to untwist the strain produced in an instant by electricity.

The results I have given are those obtained upon soft iron wires of ½ millim., but I have experimented with different sizes up to 3 millims. diameter. The results with 1 millim. diameter were quite as evident as the ½ millim., but on the 3 millim. wire the strain was reduced to 25 deg. instead of 50 deg., owing to the extreme rapidity and low electrical resistance compared with my small battery wires. On a telegraph line, the wire of which is almost entirely of iron, there must be a very great strain set up, which, however, would remain a constant, except where reversed currents are used, and in this case a constant movement of the molecules of the wire must be the result.

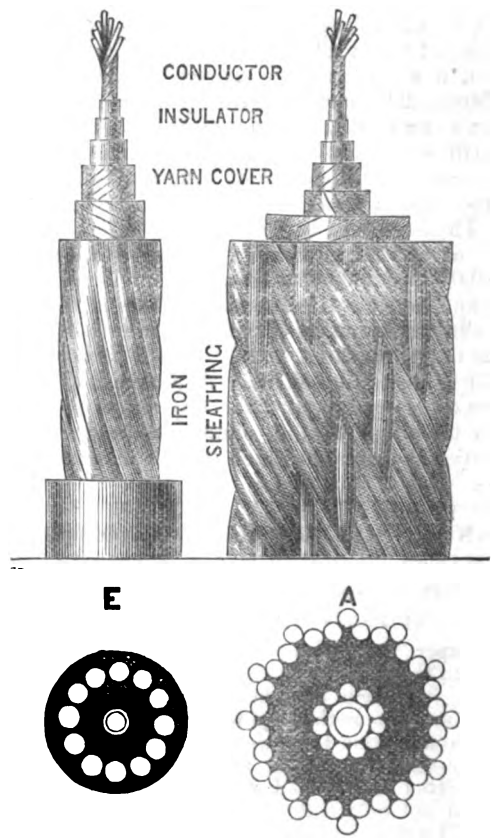
I believe it to be most important that we should determine, as far as we can by experimental research, the nature of all molecular changes produced by electricity and magnetism, and in this belief I am happy in being able to bring this Paper before the Royal Society.

LAYING AND REPAIRING SUBMARINE TELEGRAPH CABLES.*

BY A. JAMIESON, C.E.

(CONTINUED FROM PAGE 251.)

We now come to inquire of what and how a cable is composed. Here is a good specimen. In the centre we have the conductor of the electricity, generally composed of seven copper wires twisted together into a strand, in a similar manner to that in which an ordinary piece of whip cord is made. The reason that copper has been selected is this, that it has been found to be the best commercial conductor of electricity, and the object of making it up in a strand of wires instead of a single wire arises from the fact that the combined sum of the small wires is stronger, *more pliable*, and *less liable to break* than if it were composed of a single wire of the same area and conductivity; besides which, should one, two, or even three of the small wires break at any point, the remaining wires are still available for conducting the electricity, whereas a single wire, once broken, is of no further use until repaired.



This copper strand will bear a strain of 200lbs. before breaking.

Now, this simple conductor of copper wires is all that would be required for a submarine cable, were it not for the *subtle* nature of the electric force, which, unfortunately for the expense of cables, takes every possible opportunity of dissipating or running "*to earth*" as it is technically termed, and before it had got a few feet, or even inches, the current would be entirely lost in the sea. It has, therefore, to be covered with an *insulator*, or substance, capable of preventing this taking place.

All substances offer resistance to the passage of electricity, some fortunately very little, others a great deal. Those which offer a small resistance are termed conductors, amongst which are the metals—copper, silver, iron, &c., and are, therefore, selected for such, whilst gutta perch, india rubber, glass, ebonite, dry wood, and such like, offer a great resistance, many million times that of the metals just mentioned, for the same sectional area and length. Advantage is taken of this well-known fact to coat the copper conducter with layers of gutta percha or india rubber.

Gutta percha has stood the test of time better than any other

* A Lecture delivered at the Naval and Marine Engineering Exhibition, Glasgow, January 28, 1881.

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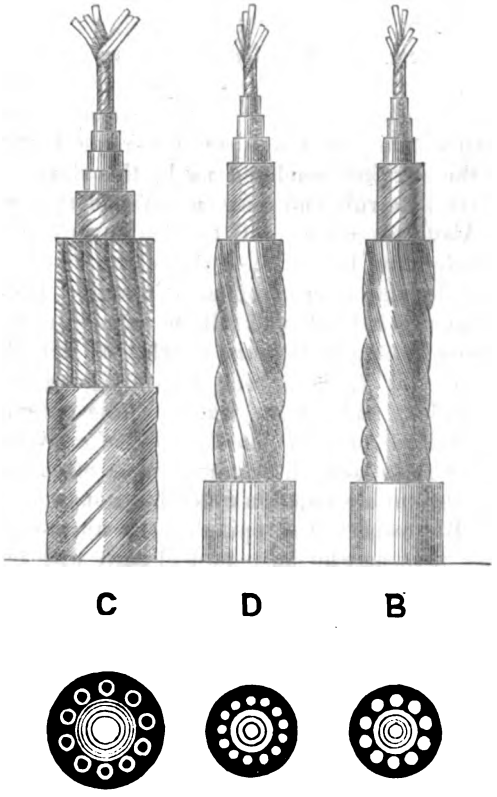
substance, being found as good as the day it was first made after thirty years, if continually kept under water. The combined gutta percha and conductor is termed the "*core*" of the cable. The diagram before you shows how the machinery is arranged for coating the wire. First, we have the wire, which is coated with a thin coating of gutta percha, and each successive coating receives a thin layer of Chatterton's compound, consist-



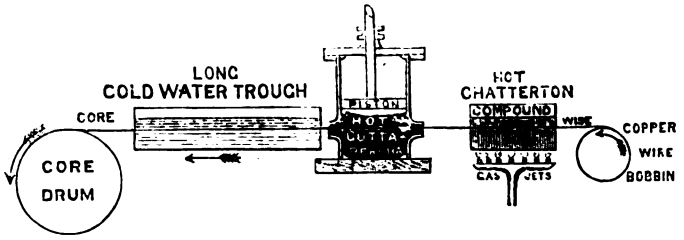
ing of Stockholm tar 1 part, resin 1 part, and gutta percha 3 parts, in order that there should be perfect adherence between the layers, and the whole form a solid rope.

Now, this core would, in every electrical sense, suffice as a perfect cable for transmitting messages; but practical reasons, arising from the soft and delicate nature of the insulator, render it necessary that it should be protected with some-

of a similar machine to the first, where it gets covered with tarred Manilla yarn, then through another trough of Clark's compound, hot, and on to the large cylindrical water tight tanks, where it gets swabbed down with silica wash, to prevent the coils and layers of cable sticking to each other.

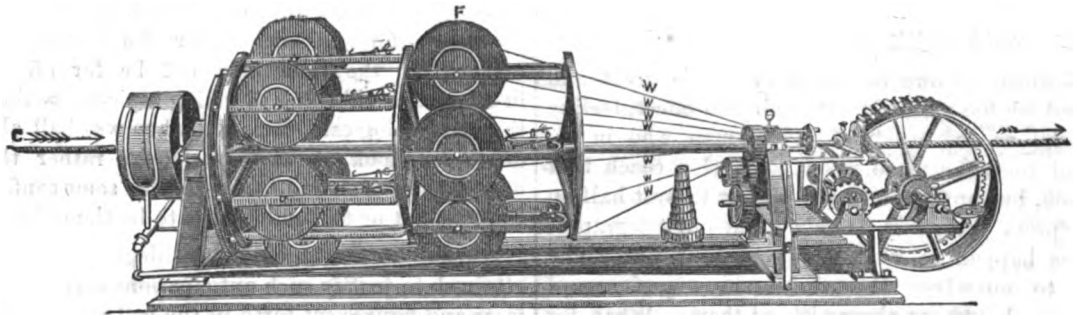
Here are a set of specimens of the different types of cables used in the Platino-Brazilian cable, which were presented to me by Messrs. Siemens Brothers while at their works. These will serve to illustrate the object of the different sections required in making a cable. This is called type A, or "heavy shore end," 18 tons to the knot, used in very shallow waters (under 30 fms.) where rocks exist, and where the cable is likely to be subjected to the chafing action of tides and currents.

Here is a lighter form of "shore end," weighing about 6 tons to the knot, called type E, used in waters up to 50 or 60 fms., where rocks are not so prevalent, and where the action of the tides and currents are not likely to be so strong as to require the heavier type just shown to you.



Next comes type B, or what is termed "intermediate cable" (3 tons to knot), used in depths from 50 to 250 fms.; a strong, serviceable cable, with, as you will observe, 10 iron wires, well galvanised, of No. 6 Birmingham wire gauge. I should here mention that all wires used in sheathing cables are previously well galvanised to assist in preventing rusting or decay.

Here is type D, a much lighter cable or "deep sea," of only 1½ ton to the mile, used in depths varying from 250 fathoms to 1,000 fathoms, and capable of bearing a strain of 3½ to 4 tons. Here is type C, "Atlantic deep sea," of nearly the same weight in air as type D, just shown to you, but specifically much lighter in water. Its great feature being combined lightness and strength, it is used for depths varying from 800 fathoms to 2,000 and over. This cable is capable of bearing its own weight on the bight in 2½ miles depth when new, and I shall have to refer to it further on in the case of a repair lately effected in 2,000 fathoms water after having been down ten years, the greatest feat yet done in cable repairing by a single ship. The sheathing is composed of steel, or homogenous wire,



thing harder and stronger; for, as it passed from the ship into the sea, and during its existence there, it would be subjected to so much rough usage that it would shortly be destroyed. For the slightest puncture from a fine needle is sufficient to seriously affect the insulation, and in the case of a very long cable a fault arising from this cause would, in time, prevent the working, unless repaired or sealed up.

The core is, therefore, covered with a serving of tanned yarn, in order to form a *soft bed*, upon which the iron wires may rest; and this is done by passing it through the hollow spindle of a revolving face plate containing bobbins of yarn.

The face plate, or frame with bobbins, F, revolves in a vertical plane, while the core, C, is pulled through in a horizontal straight line. After receiving the yarn coating, Y, it passes on through a larger machine (Fig. 4), receives a covering of galvanised iron or steel wires, W (as the case may be), laid on in a spiral form, thence through a trough containing Clark's compound (composition, 5 of tar, 65 mineral pitch, and 30 of silica), then through the centre

of great strength, bearing a strain of 50 tons to the square inch, each wire being previously covered with tanned Manila yarn. The deep sea Atlantic, and Bay of Biscay, and Indian Ocean cables are made of this type, and they have proved very serviceable indeed. The Clark's compound and yarn (or outer tape serving) is simply put on to render the life of the cable longer by preventing rusting and decay to the iron wires.

The cable having now been made in the factory, and the cable ship fitted up, she is brought alongside the wharf opposite to the factory, and transportation takes place from the factory to the cable ship.

I should here mention that a thorough and constant system of electrical testing is kept up during the whole process of manufacture and coiling from one tank to another, in order to ascertain the electrical values of the cable, as well as to detect, upon the shortest possible warning, the appearance of a fault.

(TO BE CONTINUED

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WEATHER REPORTS.

The benefits which we owe to electricity are so great and so obvious that we too often forget their full effect, feeling as little grateful as the crusty old gentleman who in his youth was glad to find a place upon some slow coach that ran twice a week, but now grumbles if he has to wait half an hour for an express train. It is only when our telegraphic communications happen to be interrupted for a single day that we take to ourselves the wholesome experience of reflecting how we should get along without them. What, for instance, would become of our crowded railway systems if we had not such means of working signals? Already we are calling on electricity to do more for us in this department, and before long we may see automatic electric signals taking charge of every line. The flourishing newspaper press of our generation cut off from its electric *sap*, so to speak, would wither up in a single night, like "the leaves of the forest when autumn has flown." Modesty forbids us to mention, in this connection, all the paragraphs which diligent sub-editors cull from our own columns. The wars and rumours of war which supply these countless journals with—excluding libel cases—their most attractive contents, could certainly not be carried on with such rapidity and dramatic effect if it were not for the services of the telegraph, which, moreover, is working here for the real good of our much suffering race, since the more costly and complex a business warfare grows, the more millions have to be spent in blowing thousands of our fellow creatures out of existence, the sooner will nations come to see the folly and wickedness of that

> "Game which, were their subjects wise,
> Kings would not play at."

In this country we happily know very little about war, except at the safe and picturesque distance of the Cape or the Balkans, but behind our "silver streak" and our fogs the weather must be a subject of perennial interest to us. Among the services rendered us by this slave of the lamp, called forth by a rub, and sent on errands that might have puzzled Aladdin's genius, not the least useful and deserving of gratitude must be reckoned those into which it has been impressed by the science of meteorology. Old-fashioned people shake their heads and talk nonsense on this subject, as on others, telling us that the weather is not what it used to be since the Yankees took to consigning it to us like tinned apples and cheap bacon. Idle people rejoice in the widening of this familiar field of conversation, and chuckle at their own discrimination as often as they are able to point out a prediction which has not been justified by results. But owners of shipping on our storm-tossed coasts, and other persons who have to deal daily with facts rather than fancies, form a very different estimate of the value of these telegraphic forecasts which have become such an important feature in modern life; and the electric wire is being recognised as one of the most certain perches of that cherub who is said to sit up aloft keeping watch for the life of poor Jack. Thanks mainly to electricity, an intelligent public interest in the weather may be said to have been formed within the last few years, an interest that must go on increasing as the same agency enables us to multiply observations and come nearer a comprehension of the laws which govern a thing apparently so capriciously variable and unstable. There is still, indeed, some room for the wiseacre who gains a great local reputation as a weather prophet by his profound manner of looking up to the clouds and oracularly declaring "It may rain and it may not." The science of meteorology is as yet in its infancy, albeit a healthy and growing infancy; but, under the fostering influence of telegraphy, the time may not be far off when nobody in his senses will think of giving a pic-nic without consulting the Meteorological Office, and when we shall all, as a matter of course, look at our newspapers rather than our barometers every morning to decide with some confidence whether the best hat or the umbrella is to be the order of the day.

Anyone in doubt as to the degree of progress already attained to justify such anticipations may be referred to the facts and figures set forth in the last report of the Meteorological Council to the Royal Society. The Meteorological Office is now in correspondence with some thirty reporting stations in the United Kingdom and twenty-three on the Continent. Forecasts are drawn up three times daily, to be supplied to newspapers, clubs, and private subscribers. Storm warnings are issued to eighty-eight points on the British coast. Private inquiries made personally at the office, as well as by letter or telegram, are answered at a small charge; but during the last year covered by the report such inquiries amounted only to 418. A very useful experiment was made in the issuing of special forecasts in the hay harvest season, which, we are assured, proved most acceptable to the farmers who allowed themselves to be guided by them. Roughly speaking, the average of success in these various

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predictions amounts, on the whole, to three cases out of four, though this average varies considerably when applied to different districts. A great part of our indications must be looked for in America, and the Atlantic is, of course, the uncertain quantity in all such calculations. If we could have, as has been proposed, fixed weather stations in this ocean, or even regular reports from such points as the Bermudas, it would be a great gain to the accuracy of our forecasts.

In American itself, where the electric wires have been so much more closely woven into the daily life of the people, and where a vast expanse of continent lends itself more readily to weather observations, a higher measure of success is naturally attainable; and "Old Probabilities," has more completely become a popular favourite, altogether superseding that mythical and much abused personage, our "Clerk of the Weather." Throughout the United States are established more than a hundred and seventy posts of observation, committed to the charge of a special branch of the army, which also takes charge of a recognised system of voluntary reports from private persons. Through this network of communications the department is able, besides giving a shrewd guess for the benefit of their neighbours thousands of miles away over the ocean, to issue weather forecasts for the various regions of the North American Continent. In the result of these forecasts there is claimed to be an average correctness of nearly ninety per cent.

In America, indeed, they are trying to get beyond mere calculations on the weather. Every now and again we receive from that side of the Atlantic suggestions which remind us of Brother Jonathan's turn for dry fun as well as for practical ingenuity. We will throw no cold water on the sanguine spirit which proposes the erection of electric suns which are to turn the night of all western cities into day, and to force a rich growth of flowers and market vegetables unparalleled in even the most favoured soils of our effete civilisation. But what shall we say to the bold projector who talks of sending up a balloon charged with explosives, to be fired at the right time by an electric spark, and thus bring down rain from the reluctant clouds, as Franklin brought lightning? All we can say is that electricity has taught us to be slow how we disbelieve anything. We should not be much surprised to read some morning that a corporation has been formed in New York for the purpose of acquiring a base of operations to carry out a new patent of Mr. Edison's for setting the earth straight in its axis, and thus doing away with the present arrangement of the seasons, which work so irregularly and unpleasantly sometimes—in an English spring, for instance.

THE NIGHT OF THE 1st OF APRIL.

(FROM A CORRESPONDENT.)

I did not go to witness that little experiment which the electric lighting contractors tried on their own account the evening before they had bargained to begin. East End crowds are not remarkable for sweetness, and I preferred to take my dose of light unadulterated. Moreover, I wanted to see it without the help of gas, and as gas was master of the pecuniary situation until the morning of the 1st of April, I declined to admit—newspaper paragraphs notwithstanding—that there was anything worth seeing until the evening of that date. I missed a great treat. What was my disappointment to learn from every leading article of the metropolitan morning Press that London had been seen overnight, not only as it had never been seen before, but as only night time could now display it. All the world was there, and I had failed to turn up on a great national occasion. Inspiration also was there, to be had as fresh as they make it, and in such plenty that it must have penetrated from Ludgate-hill into the back room of every newspaper office all the way to Charing-cross. The illuminated language of those leaders was something supernatural; and to have missed the spectacle that provoked it was enough to strike one dumb. I was on the spot, therefore, in good time on Friday. The weather had been bright, and for some weeks past the City, with all its grand and varied architecture, had looked at its very best. Gothic and Classic, Renaissance and Elizabethan, Queen Ann and Victorian, all in picturesque groupings, combined to make it a sight which the charming eccentricities even of mediæval times could hardly excel. But this was as nothing. To see London properly it must be viewed by electricity. Melrose Abbey can only be seen to advantage in moonlight, and henceforward every foreigner would be invited to arrive by the evening mail, and return before sunrise, lest his eye should be offended by sight of London in the daylight. The blue-spangled dome of heaven is sharply defined as by a nocturnal rainbow, and the palatial magnificence of municipal Cheapside, under the refulgence of electric light, takes a first place in the order of nature. The tall lights were the crowning triumphs of man's achievements. From the cloud-capped summits of those wondrous erections, which even the inspired newspaper writers could not find a name for, a shower of light bathed all the surroundings in a glistening vapour of glory. Things ugly were transformed into things of beauty, and fresh delights were revealed in things that had ceased to charm. All this I was led to expect from my study of the morning newspapers. In truthful, though uninspired, language I will tell what I really saw.

Standing at the bend of King William street I could survey a large portion of that circuit which, to use the words of the newspapers, would presently "in an infinitesimal portion of a second" be "radiant with pure white light." The lamplighter, warned perhaps by your own leader writer, had left this locality to its fate, and an unusual gloom overhung the thoroughfares before the hour of seven chimed forth. Punctually, however, at that hour three lamps on the pavement broke into light, then three more, filling up the gaps; a minute later the path across the water is marked by shining discs on either side, and by this time one is able to judge of the general effect. On the whole it is pleasant, the supply of light coming from overhead, well up, and not obtruding the source of it too painfully. It will be more enjoyable on a summer evening, perhaps, for this is a bitterly cold month. At a later hour, when darkness has really set in, then will be the time to see the lamps at their best or worst; and as the high lights, one of which confronts the stoney gaze of King William's effigy, are not to begin yet awhile, I walk away to my club. Honour compels me to mention that one of the lamps struck work as I passed by. Turning red like a lucifer match just blown out, it finally retired into utter obscurity. Its companions quickly followed this bad example, and as I groped my way over London Bridge the prospect was not encouraging. But you know the spiteful perversity of electricity; and I beg to put on record that I sternly rebuked those irreverant sightseers who impatiently denounced the whole business as a sell. Looking back I beheld virtue rewarded, the lights were burning once more, and I left them to less charitable critics till well nigh eleven o'clock.

Retracing the path I had taken earlier, it was still comparatively thronged with vehicles, and of course there were numbers of foot passengers. Plenty of light pervaded the immediate neighbourhood of the lamps, enough on the footway between them, sufficient, perhaps, on the roadway, but certainly not more than sufficient. Probably the drivers found it neither better nor worse than usual. London Bridge, though a slow, is not an intricate road to steer, and if the new light is for bare utility, with nothing to spare for show, it will suffice. The posts are artistically affixed to the centre of the cross-armed gas-lamps, which, adding the bridge coping, bring the electric globes to the same level as those on the specially erected poles along the streets, namely, about eighteen feet high. These latter are of solid, but tapering and not ungraceful construction, and the ground glass globe at their summit renders the whole a decided improvement on the conventional lamp-post. From the foot of the Bridge onwards to the Royal Exchange, and thence past the Mansion House along the first half of Cheapside, this pattern of lamp prevails; and as the light is neither stinted nor disfigured by any sort of reflector, the general effect is very pleasing, though some people may wish for a little more of it.

Having written thus much for the ordinary series of lamps covering this area, my pen is set free to say its level worst about the extraordinary part of the programme. Iron lattice-work columns, borrowed, I should imagine, from the deepest of railway cuttings, rear themselves some eighty feet high with semaphorial impertinence, one right in front of the royal personage previously mentioned; another cuts the Duke of Wellington's horse in twain, with a leg of His Grace on either half, whilst the Guildhall frontage, where the only view people care to take of it is to be had, is split from top to bottom. Adelaide-place, St.

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Mary Woolnoth, and one corner of the Mansion House are similarly graced. But these are daytime prejudices. Under the new teaching, night would allay our artistic sufferings, and send us æsthetically to bed. I hurried onwards, therefore, to behold London as it really *is*, the magic picture of which had been graphically drawn for me that morning by every penny-a-liner on the job. The high lights were now in full blaze, and, for beacon lights, they did pretty well; for lighting the ground beneath they served uncommonly ill. Evidently something was amiss with King William. A slight breeze was blowing. The houses behind him were all aflare with light; but, rocking to and fro, seemingly in the midst of it all, was a black mass of gigantic scaffolding, the like of which has never been seen away from the mouth of a coal mine. I expected to see the whole fabric come toppling over, and the inoffensive sovereign buried amidst the ruins before I could reach the spot. A few paces more reassured me—if reassured it can be called. I scuttled past with a deep sense of humiliation, recollecting that only yesterday a common working man insisted, despite my confident denials, that "*them here lamps 'll throw shadders.*" Shadows they did throw, and no mistake. On the face of St. Mary Woolnoth the tiny lattice-work of the slender column in front, with its tackle no thicker than your thumb, is reproduced like the gratings of Hungerford Bridge, and the chain is magnified to the size of a ship's cable. Along the asphalted road of Queen Victoria-street, again, this dancing nightmare disports itself at full length, bedazzling horses and bewildering men, who step over it as if it were a thing of substance darkly obstructing the way. But how about the civic palaces? Casting one's eyes eastwards, Lombard-street is spanned by a gloomy archway of huge dimensions, that hand of man ne'er built. One side of the Bank is capering in the air, and the other side has fled. The Mansion House is sliced fantastically, and that lovely block of buildings at the opposite corner is converted into a brand-new pyramid, curiously carved.

I'm going to "poll early and often" against those high lights.

Down Cheapside I breathe freely again. Here I renew my acquaintance with the "ordinary" lamps; and they remind me that I was omitting to do one act of justice to the open space just left in my rear. If you stand on the Royal Exchange flags with your back to the hideous lamp aforementioned, the building itself assumes a really charming aspect. Two short lamps are burning at either flank, and these, with perhaps some assistance from on high, give the whole front of it, and its sombre recesses, the semblance of a transparent stereoscopic picture. The thought occurs to me that my enemies, the poetic reporters, must have all stationed themselves on this spot. I forgive them, and pass on.

Westwards I come upon a different stamp of light. The ground glass globe is smaller, it is mounted lower, and attached somewhat rudely to the orthodox lamp post, minus the lantern, and is overhung with a trough-shaped reflector. The pavement is as brilliant as day just underneath, and costermonger's wares show off to advantage thereby. Some people offer their opinion that the lighting here, as a whole, is better. The reflectors, however, deny all illumination upwards, and, for myself, I like the more bountiful, if less intense, display east of King-street. By the way, a great deal has been said about the steadiness of this class of light—I mean the light that is on trial from this point westwards. All I can say is that it was exceedingly uneven all along the line when I inspected it; whilst, barring their momentary break-down, there was no noticeable flickering in the globes of its more expensive rival. Happily there was no attempt at grandly illuminating either St. Paul's or Ludgate-circus. The route was covered in a business-like way, with neither too few nor too many lights for the purposes of traffic in this locality; and as there was nothing to be seen on Blackfriars Bridge I took a sharp turn to Cannon-street.

Here, under the portico of the terminus, was something worth going to see. The gas lights were all extinguished, yet the courtyard was literally like noonday. Inside the station the effect was the same, and on turning one's eyes away from the suspended lamps overhead, it was hard to say what better or more natural light would have been afforded by a summer's day sun. Liverpool-street is a ghastly vault compared with the inside of this cheery edifice; and, outside, the contrast favours still more the choice of the South Eastern. Here a happy idea is hit upon for giving nearly the full benefit of a naked light without any unpleasing dazzle—the globes are ground only half-way up. At least that was my first impression of the two lamps outside, though not confirmed by a subsequent inspection. This is really, in a measure, satisfactory; and if I have not said as much for the rest, it is because I want that "splendid future," which people who understand these things predict for the electric light, to be realised in my own time, and not at some remote age when your correspondent has ceased from scribbling, and his weary eyes are at rest.

CORRESPONDENCE.

THE POSTMASTER-GENERAL AND THE TELEGRAPHISTS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Mr. Macliver, in his letter to *The Times*, has taken, I fear, a too hopeful estimate of the ability of Mr. Fawcett to surmount the *vis inertia* at the Post Office, especially as the telegraphists refer to a long-standing grievance. I recently solicited the attention of Mr. Fawcett to several palpable instances of breach of faith on the part of the permanent officers of the telegraph department, which had operated most seriously to my prejudice and injury, but the only result was a reply from the secretary (Mr. Patey), stating that he was desired by Mr. Fawcett to say that "the Postmaster-General did not feel called upon to enter into the past history of my case." Probably no one would be inclined to question Mr. Fawcett's intentional fairness, or the honourable intention of the telegraphists' delegates if they knew anything of the character of either, and therefore it seems to me a matter for regret that such a circular as the Post Office has sent out should have received Mr. Fawcett's sanction. It appears to be commonly known that the representatives selected by the telegraphists to attend the interview with Mr. Fawcett were surprised to find with him on that occasion not only the permanent officers at head-quarters, but other familiar faces of certain local superiors, to confront whom rendered the so-called interview of the telegraphists with Mr. Fawcett rather a personal than a public matter. Possibly Mr. Fawcett knew nothing of their presence, as they are not named in the circular. If he had known that they had been invited to attend, and were present, he would, I believe, have understood the diffidence and difficulty caused by fearing to offend those towards whom certain of the delegates stood in such intimate and delicate relationship. The telegraphists are never likely to obtain justice unless other means are adopted to ascertain their views. It is somewhat singular that the matter to which I referred as having been brought by me to Mr. Fawcett's attention was a proposal to substitute a definite and simple system of telegraphy for that of the Morse recorder and sounder, upon which the Post Office almost wholly relies. This I did, believing then, as I do now, that such skilled and practised manipulation as at present causes the department so much anxiety would thereby be rendered unnecessary. At the request of the Post Office I prepared both transmitting and receiving instruments, I nominated representatives on my own behalf to meet representatives nominated by the Post Office at a trial which the authorities themselves proposed to make of the instruments, but that trial has never taken place, nor have the referees ever met or ever been asked to meet, and yet this is the matter which Mr. Patey says Mr. Fawcett "does not feel called upon to enter into." I suppose there is no higher authority upon the working of land lines than Mr. Latimer Clark, who signed the following report:—

"From what we have seen, and from the information with which you have furnished us, we consider that the Herring instrument is superior to the Morse instrument in the following respects:—

"1st. We are of opinion that your instrument will work on all ordinary circuits at a greater speed both for hand and mechanical sending than the ordinary Morse now in use, in consequence of the dashes being made in the same space of time as the dots.

"2nd. In comparison with the Morse the signals given by your instrument are necessarily more legible, and may be more accurately deciphered, in consequence of the dashes being upright, and of uniform size and character. Owing to the vertical position of your dashes, it is impossible for a clerk to be in doubt as to which are dots and which are dashes, as is so liable to occur with the ordinary Morse writing.

"3rd. Owing to the contacts for dots and dashes being alike, ordinary telegraph clerks can learn to work your instrument with greater facility than they could the Morse.

"4th. There is no doubt that the saving in the cost of paper for your system is very considerable, and would form an important item of economy in a year's work. This saving would, probably, be equal to 65 or 75 per cent. The compactness of the messages by your system is very remarkable.

"5th. With reference to mechanical sending, the punched paper used for your system is more simple than that required for the ordinary Morse, and it is also stronger, owing to the fewer perforations—exactly half the number required for the Morse signals.

"6th. Your instrument is peculiarly adapted for reading by sound."

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Not only has the Post Office failed to keep its promises with me, but it unaccountably leaves unchallenged this report of Mr. Latimer Clark. No doubt the authorities will manifest considerable energy and probably much vindictiveness should the telegraphists strike, but the department will be wholly unable to prevent serious public inconvenience. Those available members of the corps of the Royal Engineers, who have from time to time been taught "Morse," will, no doubt, be employed by the Post Office, and some of the young women who were recently dismissed may possibly be willing to re-enter the service; but very few either of the soldiers or the girls can read from the Morse sounder, which has recently been adopted so extensively. In fact, the prospect is by no means satisfactory, look which way we will, and certainly, after an exhibition of ten years' patience, the public also has a right to complain.—Yours, &c.,

RICHARD HERRING.

27, St. Mary's-road, Canonbury, 5th April, 1881.

[Our correspondent is mistaken as regards the Royal Engineers; sound reading is an essential part of their training. We make this correction in the interest of the telegraphists who might be misled by the last paragraph of Mr. Herring's letter.—ED. *E.*]

MAGNETIC STORMS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Through your columns I should like to submit to electricians in connection with cables in various parts of the world the following note of observation:—

27th Sept., 1880.—To-day there seemed to be a magnetical force at work on the instrument (Thomson astatic) which interfered very much with tests. I proved this by freeing the instrument from everything, guarding against currents of air and every other extraneous disturbance, and then watched the behaviour of the "spot." I did this for an hour, and at irregular intervals throughout the whole time the needle was subject to spasmodic jerks, the "spot" indicating as much at times as 200 divisions on either side of zero.

This is a phenomenon I have not encountered before, and though I attribute it to the passage of a heavy magnetic or atmospheric-electric storm, I should like to know if on the date in question any corroboration could be furnished by other observers.

I may add that I was also testing on the 12th and 13th August last, the tests being completely vitiated. I recognised at once the presence of a magnetic storm in conjunction with the usual time for meteoric showers and general magnetical disturbance. It was satisfactory to see afterwards from the reports in your journal that this disturbance was universal so far as the Eastern hemisphere was concerned. It will probably be new to learn that we on this side were also visited by it.

Earth currents, magnetical storms, &c., being at present the subject of inquiry and discussion, any registered fact *from a distance* ought to be valuable. But it must be borne in mind that cable people are at a disadvantage in the respect of regular observations, notably through the interposition of condensers between office and line. Unless one happens to be testing at the moment at the legitimate end of the wire, it is unlikely that anything unusual will be noticed. If this difficulty could be overcome, and proper records made simultaneously throughout the world (most cable stations keeping Greenwich time), the results, I am sure, would be of such a nature as to settle many points at present in dispute, and would be a great step in the direction of the development of the science of meteorology.

Hoping, Sir, that those few remarks will not take up too much of your space, I am yours, &c., GEO. THOMAS.

Pernambuco, S.A., 15th March, 1881.

A GLANCE INTO THE FUTURE.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I have a theory which, no doubt, will one day become an accomplished fact, however ridiculous it may appear, viz., the transmission of individuals by telegraph, either by wires, or by light, or any other means which may be used in the future.

I will briefly give the reasons for believing this to be possible. We know how, in electrotyping, the copper, for instance, is continually replaced in the solution from a plate or lump of copper as fast as it is deposited on the object immersed. Electricity is the prime mover, and the constant structure of a definite chemical compound is the cause for the effect produced. Were this latter not the case it is doubtful whether electrotyping would be possible. Further, it may be assumed from our present knowledge that the power of the brain is very similar to an electric battery, and most likely "nerve currents" are "currents of ordinary electricity." We also know, taking one instance, that if the claw of a crab be removed it will grow up again without any framework to go upon, just as if the "flesh molecules" had a definite shape, and kept piling up upon each other, producing the shape of a claw, just as cannon balls when piled up can only produce pyramids. I do not give this as a theory, but merely as an example for ordinary comprehension. I maintain, therefore, if we could only get the "elementary molecule" of a man, he could be built up from it. Such, in fact, is conception, and the after phenomena till death. Now, if we had a "human solution," say any meat in solution, at New York, and a man be dissolved by electric means in London, I can quite conceive the possibility of building him up again from the solution in New York at the same rate at which he would dissolve in London (always bearing in mind my earlier remarks). Of course this idea is of no practical value at present; still, every new idea leads to discoveries, by many minds being turned in one direction, and this is my only excuse for intruding upon your valuable space.—Yours, &c.,

13, Bruton-street, W., April 4, 1881. DAVID SALOMONS.

RESEARCHES ON THE VOLTAIC ARC.

When an electro-current is established between two conductors of the same nature by means of a gaseous medium, ordinarily the vapour of their substance, an inequality of temperature between the portions of the conductors which are contiguous to the medium is observed, and it is found that the positive electrode has the highest temperature. This effect is seen in a marked degree when the current is furnished by a constant current in one direction, such as that from a battery.

It is an old idea to attribute this phenomenon to a thermo-electric origin. According to the application of the principle or equivalence of heat to electric phenomena, as results from the works of Helmholtz, Clasius, and Thomson, a disengagement of heat at the point of junction of two heterogeneous substances is accompanied by an electromotive force acting in an inverse direction to the current. M. Edlund has long ago remarked that the resistance of the arc, considered merely as a conductor, does not account for the decrease of strength in the current; and quite recently M. Joubert, in his investigations on magneto-electric machines, arrived at the conclusion that the resistance of the arc is very feeble, that the difference of potential which exists between the two carbons is due for the most part to an electromotive force resulting from a phenomenon of polarisation, of which he reserves the explanation.

The subject has been taken up by M. Le Roux, who has communicated his results to the French Academy. It has been shown by M. Wartmann that if we suspend for a fraction of a second, even one-tenth of a second, the passage of the electric current in the carbons, the arc will re-establish itself without it being necessary to bring the carbons into contact again. This fact is explained if we reflect that the vapour of carbon, which chiefly constitutes the arc, remains for some time after the cessation of the current, and also that the warm gases which bathe the carbons are conductors, as M. Edmund Becquerel has shown.

Admitting that the passage of the current causes a difference of potential between the two carbons, this difference ought to subsist for a certain time after the current has ceased, and since there exists between the still warm carbons a conducting medium, this difference of potentials ought to be manifested on a galvanometer joined in circuit. With a galvanometer of high resistance put into circuit at will by a hand key, the existence of this electromotive force has been proved by M. Le Roux about one-fifth of a second after the stoppage of the battery current through the arc. The effect is stronger the shorter the arc. The experiment succeeds also with platinum reophores instead of carbon, and M. Le Roux concludes that the effect is thermo-electric; the carbon being positive in relation to its vapour, and in a degree proportionate to the temperature.

Another phenomenon of the electric arc is the peculiar hissing or whistling sound that it emits, a phenomenon which had been little studied until M. Niaudet turned his attention to it recently. Nevertheless, it is necessary to take it into account in measuring the arc.

To investigate the subject, M. Niaudet availed himself of the galvanometer of M. Deprez, an instrument which can be constructed in two ways. It can be made with a few turns of thick wire and feeble resistance, for measuring intensities of current,

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or it can be made with a great many turns of fine wire and high resistance, so as to serve for measuring the electromotive forces or differences of potential between two points of a circuit. In the one case it gives its readings in webers and in the other in volts, if properly gauged.

M. Niaudet has placed a Deprez intensity galvanometer in the main circuit of the arc, and a potential galvanometer in a shunt or derived circuit, and by these means has observed the variations of the arc. They reveal themselves instantaneously.

The results observed are as follow :—The difference of potential between the two carbons has two values notably different, the greater when the arc is silent, the less when the arc whistles. The needle of the galvanometer moves suddenly from one position to another in a dead-beat fashion, when the silence begins or stops. If one follows it with the eye, at the same time as the ear hearkens the whistle, the least noise is found to be accompanied by a sudden jerk of the needle. On the other hand, when the silence is established, the needle remains at rest for a long while. It will be understood that the changes in the potential of the arc are accompanied by variations in the inverse direction of the strength of the main current.

The following measurements, made by a dynamo-electric machine, will give an idea of the changes taking place :—

Intensity of Current, in Webers.	Difference of Potential, in Volts.	Remarks.
34	54·3	Silence.
36	43	Whistling.
34	49	Silence.
43	41·4	Whistling.
38	49	Silence.

A complete theory of the voltaic arc ought to take this curious effect into account.

EASTERN EXTENSION, AUSTRALASIA, AND CHINA TELEGRAPH COMPANY (LIMITED).

The fifteenth ordinary general meeting of this Company was held on Wednesday, the 6th inst., under the presidency of Mr. J. Pender, M.P.

The SECRETARY having read the notice convening the meeting and the minutes of the last general meeting, which were approved and signed by the chairman, the report was taken as read.

The CHAIRMAN said: I will make a few remarks on the report, so that you may have some little explanation. The gross receipts for the half year ending the 31st of December, 1880, were £193,435, as against £165,930 in the corresponding period of 1879, showing an increase of £27,504. Of this amount, however, £21,133 was received from the Australian and Manila Government, on account of subsidies, as follows:—From Australian Governments, for six months subsidy in respect of the Australian duplicate cable, £16,200, and from the Government of the Phillipine Islands, for six months subsidy in respect of the Manila cable, £4,933, making together £21,133. Excluding these amounts the actual increase was £6,371. The working expenses for the half year, including income-tax, came to £57,592, against £57,451 in the corresponding period of 1879, or an increase of £141. In the latter period, however, a sum of £2,740 was charged for expenses in connection with the Australian duplicate cable, which does not appear in the present accounts, so that the actual increase is nearly £3,000, which is due to the opening of the Manila cable and to the introduction of a night and day service throughout the whole system. The net revenue for the half year was £93,493, against £97,247 in the corresponding period of 1879, showing a decrease of £3,754. This is caused by the contribution of £14,600 to the sinking fund for redemption of the Company's £740,000 five per cent. debentures when they become due. But for this the net revenue would have shown an increase of nearly £11,000. If, however, we compare the working of the whole of the past year with that of 1879 the following satisfactory result is seen. The receipts, exclusive of subsidies, amounted during 1880 to £320,354, against £303,957 for the year 1879, giving an increase of £16,397. The actual working expenses during 1880 were £107,975, while for 1879 they were £113,406, showing a decrease of £5,431, notwithstanding the fact that during the past year the Manila cable has been opened and a day and night service established throughout the Company's system. Now, gentlemen, as to distribution. During the half year an interim dividend of 1¼ per cent. has been distributed, and another of similar amount has now been declared, together with a bonus of 1s. per share, which will be payable on the 14th inst. These amounts, together with those paid during the first half year, make a total payment of 6 per cent. for the year 1880. The balance of £69,178 which remains after payment of all claims has been carried to the reserve fund, which, including that amount, now stands at £217,268. Now, gentlemen, I have given you these figures, and I hope that they will be satisfactory. At the present moment our cables are in perfect working order. I believe I have seldom been able to say that all our cables were in perfect working order, but during the year, nevertheless, we have had to spend something like £40,000 on the repairs of our cables. If we could only find a cable that would not require to be repaired, our prosperity would be even more marked than it is, but we are doing everything that science can aid us in to get a cable that will be free from the action of the teredo, and will stand wear and tear better than those we have so far been able to lay. But, nevertheless, gentlemen, it is a very great satisfaction to know that our cables are in such a position that we can repair them, although our ships are pretty actively employed. I may mention that they have been employed during the greater part of the half year, one of them having been at sea 122 days and another 144 days. But, as I have said before, every piece of cable we pick up we are relaying with a superior type of cable, and by and by I hope that we shall have such a system as will entail on us less expenditure for repairs than we are subjected to at the present moment. I will just say one word with regard to our system. As you are aware, we are now paying at the rate of 6 per cent., but we are paying it with a duplicate system, which gives a security we did not possess with a single cable; and had we not duplicated our system the 17 days that we were interrupted on the Java-Australian section in October last would have been a complete interruption, whereas we have not felt it in the present instance in any decrease in our revenue. I think, gentlemen, that these remarks embody pretty much all that I have to say excepting that our system is now very complete, our Manila system is likely to contribute fairly well to the general system, and I think, looking to the fact of the steady increase in telegraphy wherever there is anything like an improvement of trade, and believing, as I do, that we are now entering on a cycle of good times, after having passed through a cycle of bad times, I hope that telegraph property will improve as trade improves. Now, gentlemen, with these remarks, I beg to move the adoption of the report.

The VICE CHAIRMAN (the Right Hon. W. N. Massey, M.P.): I beg leave to second that.

The CHAIRMAN: The resolution is "that the report and accounts of the directors now submitted be received and adopted, and that a dividend be now declared of 2s. 6d. per share, together with a bonus of 1s. per share (both free of income-tax), payable on the 14th instant, making, with the previous distribution, a total payment of 6 per cent. for the year 1880." This resolution has been seconded by Mr. Massey, and if any gentleman has any remark to make before I put it to the meeting, I shall be glad to hear him.

Mr. JOHN NEWTON: I beg to congratulate the directors, sir, on the improved position of the property, inasmuch as, although the net revenue is less, you have increased the dividend by 1 per cent. I think, seeing the substantial sum to the reserve fund for the purpose of a sinking fund, a very large sum is transferred to the reserve fund proper, although less than in the corresponding period of last year; but, still the total of the reserve fund is now so large that I think you will now begin to consider whether enough has not been set apart for that purpose. While congratulating the directors on the improved position of our affairs, I can also congratulate the directors and the shareholders on the improved form in which the accounts are now rendered. You have given us that for which I struggled so much at our last meeting—a division and abstract of the amounts expended on repairing the cables. It is one of those important items that we should have. We see in the accounts what is spent on actual repairs, we see what is the actual cost of new cable that is put into the system, and we also see how much we pay for the ships when in harbour. I think, sir, I can take to myself some little credit for the pertinacity with which I have struggled for this information, and although you and I came into collision on that occasion, I think the result is such that I may congratulate myself on having been one in bringing about a system of accounts which is most satisfactory to thousands of shareholders who have not the privilege of attending these meetings. I think I can claim credit for that, and I also think that on that occasion words were said to me which ought not to have been used. I am not likely to be deterred from criticising the directors or the accounts in future from the fact that I have been attacked in the manner I have, and I am now going to ask for a still further improvement in the manner in which you issue these accounts. I am justified in asking for this information, from the fact that two of your colleagues are on the Brazilian Submarine Company, who publish accounts which you could adopt with great advantage and satisfaction to the proprietors—I refer to the monthly traffics published by the Brazilian Submarine Company. If you added that information to these figures you would make this document more complete. Besides that, I wish to ask a question relating to the cost of repairing and maintaining these cables. We have spent, on an average, £40,000 a year for the last six years for this purpose, and the question I would ask is, Is it not possible for the great telegraph systems to come to some arrangement with the Telegraph Construction and Maintenance Company to do this work cheaper, by a contract or some form of annual payment, by which a certain sum would be set aside for the purpose, something after the same fashion as the great shipping companies? They set aside so much annually for the purpose, and that fund becomes in course of time a very valuable factor in the stability and strength of the Company. I just throw out that suggestion, that it is possible we may have a system of insurance adopted which would render certain and permanent the dividends paid to the shareholders, and much more than we now get.

Mr. VARLEY: I congratulate you and the Board on the splendid investments you show as constituting the reserve fund, and the noble amount at which that fund stands. I remember, some few meetings ago, the chairman suggested that we might eventually get 6 per cent. as a return for our investment, and perhaps more. I would ask whether, as the chairman takes the view that is generally taken, that we have entered on a cycle of good times—we might not have this 1s. per share bonus added to the interim dividends as well.

The CHAIRMAN: Gentlemen, in regard to the remarks of Mr. Newton on the question of the reserve, I think, with a sum of a little over £200,000, compared with a capital of £3,000,000, that you will agree that we have not yet got at the point in the reserve fund which ought to be quite satisfactory [hear, hear]. The moment we get at the point that renders us perfectly independent, and we could renew the large links of our cables without appealing to the public or the shareholders for money—then will be the time to begin to talk of distributing larger dividends. This is the first year that we have paid this additional 1 per cent. Give us a little time; let the reserve fund get some addition, and then I think, if the traffic grows, that the shareholders will be quite entitled to participate in such prosperity; but the reserve fund must also participate. I will not allude to anything in the past that occurred at these meetings, because I think that sometimes temper, probably both on this side of the table and on the other, gets the

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better of judgment for the moment. All I will say is that we are as anxious on this as you are on that side of the table to promote the best interests of the Company, and if we have wrangled sometimes I don't know that there is very much harm in it, and that sometimes we elicit some sparks of truth and some valuable suggestions which, come from whatever quarter they may, we are always glad to receive. With regard to the credit which Mr. Newton says he has taken, I am quite free to give credit to any gentleman for remarks which we think valuable, and the more often such remarks are made the better they will be appreciated by the directors. There was a suggestion made, that we should put into our reports the monthly traffics, but as we publish them monthly in the newspapers I don't know that there is any great point in putting them into our reports. If, however, it is for the advantage of the body of the shareholders who are scattered all over the country, I have not the slightest hesitation in giving them every information, so as to guide them as to the progress of the Company. We hide nothing from the shareholders, and are only glad to give them every information in our power. As to the suggestion about the ships, I confess that at one time I held Mr. Newton's views. In fact, when the Telegraph Construction Company was formed I happened to be very closely connected with it, and was its chairman for some years; and so impressed was I at the time with the idea embodied in the suggestion of Mr. Newton that the word "Maintenance" was connected with the word "Construction," and so it was named Telegraph Construction and Maintenance Company. I think, however, that Sir James Anderson would very soon convince you that we can ourselves manage our ships tolerably well, and we think that we can repair our cables a trifle cheaper than the Telegraph Construction Company would do it for us. I think we have in some measure proved that. I have not a word to say against the Telegraph Construction as to the way in which they do their business, for it is done exceedingly well; but they have one peculiarity, which all other companies have, that they like to be paid fairly well for what they do. We have a great number of small repairs, and we should require to have a fleet of the Construction Company's ships on the spot. In short, if Mr. Newton, good accountant as he is, went into figures, he would see that we are doing the best, under the present system, for the Company. Mr. Varley has spoken about the bonus. If we can get a cycle of good times, and we can increase our income sufficiently, depend upon it we should not object to add 1 per cent. more to the bonus each half year. With these remarks I will now put the motion.

Mr. PRUST: Mr. Chairman, I have only just entered the room, and although perhaps I am one of the oldest shareholders, having held my shares from the very beginning, this is the first time I have ever attended a meeting of the Company, because I felt a degree of happiness in its progress. I came here to-day to say what a very large sum we can save, and how much consolidate our position by amalgamating with the Eastern Telegraph Company. I hold shares in both, more particularly in this, and have gone on increasing my holding, and intend to do so, because I think it is a first-class property. But I have looked into the matter, and I am aware that you gentlemen on that side of the table have associated yourselves more or less with all the telegraph systems that exist, and I find that the chairman and directors of this company are also directors of the Eastern, of the Anglo-American, and of the various other companies, and, no doubt, from that reason you are more acquainted with the details of the working; but I think a very large saving could be made, providing you and the directors can see your way, in our interests, to consolidate our position, by reducing our expenditure, and by an amalgamation of these two companies. There are the same offices, the same staff of clerks in London, and, I daresay, the same powerful workmanship would be enabled to combat the difficulties against which you have to contend. I find in this City of London there are firms earning £2,000,000 a year, and, perhaps, you find two first class men, partners, actively working together; but here we have something like thirteen gentlemen conducting our business, and thirteen connected with the Eastern system.

The CHAIRMAN: Look at your report.

Mr. PRUST, continuing: I believe you would work as satisfactorily as you do now if you amalgamated. I throw this out as a suggestion, and I don't say that it is possible; but here, in this Company, where we are all working for the best, I say that it would tend to consolidate our position, and the greater our consolidation the greater is the certainty that we can keep from innovations and the things now taking place as to the Anglo-American Company. There is no doubt that this system is not a gambling system, it is one of solidity; and the greater our consolidation, the greater is the certainty of staving off the wicked manœuvres of those who would try to injure us. I respectfully ask you whether in your wisdom and long experience you can see any probability of working out this financial system, whereby we can save something like £10,000 a year, giving us an extra 1 per cent. I don't say it is possible, and I am afraid it is impossible; but I ask you if you can do it. You have on both companies the same directors, the same officers, the same staff, the same secretary [voices, "No, no."] I have nothing more to say, and I trust you will understand that I am deeply grateful to you. I have held in the property for a number of years, I have increased my stake, and I intend to increase it, believing it is honestly and thoroughly well conducted; but I put it to you whether there is a possibility of consolidating our position by amalgamating these two systems, because you are really one.

The CHAIRMAN: This question of amalgamation has been pretty well discussed over a period of years, and I think we have probably carried amalgamation as far as we possibly can, having regard to economy. If we were to put the two companies that have been named together, the word monopoly might be applied to it, which is very odious to most English ears, and I believe the saving would be very trifling indeed, and the disadvantages would be very considerable [hear, hear]. We economise in every way. We have this large capital of £3,000,000 worked alongside of the Eastern, with its £5,000,000. We have them in the same office, we employ as far as possible the same hands to do the work of the two companies; in fact, in every way almost we have brought about the economies which would be brought about if the two companies were together. The disadvantage of amalgamation is, in the first place, monopoly, and, in the second place, you could not get the men to attend and do all the work. It must be done on different days, and if done on separate days you must pay men for the work they do. We always help one another. I don't know that we borrow money from one another, but in ships, and so on, we are always ready to assist each other. I don't think that this system which has been built up, and which is not only the admiration of the world but the envy of many parts of Europe, could have been established had it not been built up by the respective companies being separately formed, and then, when the time arrived, brought together. We never could have made this international system of telegraphy, embracing nearly £20,000,000 sterling, unless it had been by a few men who could work together without jealousy, with one object; and any one who looks abroad and thinks for a moment will see the enormous amount of money that has been saved by the Eastern Company laying a cable to the Cape. They did not go before the public to ask for money—I am speaking now of the sister company, but the Eastern Extension Company, too, has aided in some degree in the construction of that cable. In other words, everything that has been done by these companies has made this Company a great, a growing, and fairly profitable company, and, above all, a highly respectable investment. Now, gentlemen, with these remarks, and thanking you for your suggestions, I beg to ask you to adopt the resolution before the meeting. Those in favour will signify the same in the usual manner. On the contrary. Carried unanimously.

The next resolution which I have to propose is, "That Sir Thomas Fairbairn, who now retires by rotation, be and is hereby re-elected."

The Right Hon. the Lord MAYOR: I have much pleasure in seconding the motion.

The CHAIRMAN: Those in favour of the resolution will hold up their hands. On the contrary. Carried unanimously.

The next resolution is, "That the Right Hon. Viscount Monck, who now retires by rotation, be and is hereby re-elected.

Mr. F. A. BEVAN: I have great pleasure in seconding the motion.

The CHAIRMAN: Those in favour of this motion hold up one hand. On the contrary. Carried unanimously.

The next resolution is, "That the Right Hon. W. N. Massey, M.P., who now retires by rotation, be and is hereby re-elected.

Sir JAMES ANDERSON: I have great pleasure in seconding that.

The CHAIRMAN: Those in favour of the resolution. Those against it. Carried unanimously.

Mr. HODSON: I beg to move "That Mr. Henry Dever and Messrs. Quilter, Ball, and Co., be, and they are hereby appointed auditors to the Company for the ensuing year, at the remuneration of £50 each."

Mr. PATERSON: I shall have pleasure in seconding it.

The CHAIRMAN: It has been moved and seconded, "That Mr. Henry Dever, and Messrs. Quilter, Ball, and Co., be, and they are hereby appointed auditors to the Company for the ensuing year at the remuneration of £50 each." Those in favour of the motion. Those against it. Carried unanimously. That closes the business.

Mr. WILLIAM ABBOTT: Before we separate I have the pleasure of proposing that a hearty vote of thanks be given to Mr Pender and his colleagues for their able administration of the affairs of the Company. I well remember at previous meetings, when you brought forward a recommendation from the board that certain extensions should be made of this Company, to consolidate your position and strengthen it, you were met with the pretty significant outcry, "Why not leave well alone." That has been the constant cry with the Eastern and the Eastern Extension Company. We now see that what the directors recommended is the right policy, and we are reaping the fruits of it; and therefore I have very much pleasure in proposing a vote of thanks to you and your colleagues for the energy and enterprise you have shown in the administration of our affairs.

A SHAREHOLDER seconded the motion, which was carried unanimously.

The CHAIRMAN: On behalf of my colleagues and myself I beg to state that it is a very great satisfaction to us to have such unanimity of opinion. Your property is, I believe, a progressive property, and it is pleasant, coming from all sources, to find that our labours during the last half year have not been without fruit, not only in giving an increased dividend, but also in gaining the approbation of the shareholders.

The proceedings then terminated.

THE GERMAN UNION TELEGRAPH AND TRUST COMPANY (LIMITED).

Report of the directors to be submitted to the ordinary meeting, to be held at 66, Old Broad-street, on Tuesday, April 12:—The directors beg to submit the accounts and balance sheet for the eight months ending 31st December, 1880, including in the accounts the coupon to that date receivable from the German Union Company of Berlin. The accounts will in future be made up to the 31st December, instead of the 1st May as heretofore, so as to cause no delay in the distribution of the dividends receivable from Berlin. The total receipts during the eight months amount to £14,486 12s. 7d., which, with a balance of £51 1s. 5d. carried forward from last account, make a total of £14,537 14s. The working expenses for the same period amount to £352 1s. 1d., leaving a balance of £14,185 12s. 11d. Out of this amount an interim dividend of 5s. 9d. per share was distributed on the 21st January last, and the directors now beg to recommend the payment of a further dividend of 8s. 3d. per share, making a total distribution for the year of 14s. per share, free of income-tax, or at the rate of £7 per centum per annum. The directors have also written off £130 from the expenses of formation of the Company, thereby extinguishing that item, and leaving a balance of £139 12s. 11d. to be carried over to the next account. The Company's cable and land lines remain in good order and condition. The total receipts from all sources of traffic show a very marked increase. The total traffic between Germany and Great Britain has nearly doubled since the year 1874, and this satisfactory result is attributable in a great measure to the introduction of the single word tariff in 1878. The traffic sent by the various telegraphic administrations over the Company's lines has almost quadrupled during the same period. According to the Articles of Association, Count Oscar Reichenbach, one of the directors of the Company, retires by rotation, but, being eligible, offers himself for re-election. The auditor, Mr. Henry Dever, also retires, but offers himself for re-election.

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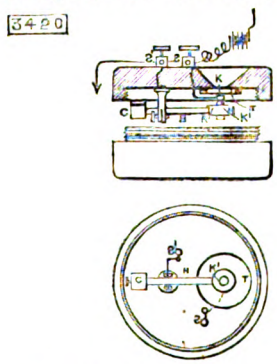
ABSTRACTS OF SPECIFICATIONS.

3310. IMPROVEMENTS IN INSULATING TELEGRAPH CONDUCTORS, AND IN THE MODE OF AND MACHINERY FOR MANUFACTURING SAME, &c., *E. T. Truman.—Dated 14th August*, 1880. 4*d*.

The object of the invention is to make the stranding and covering of the wire one continuous operation, instead of two as heretofore. The wires are wound on bobbins, which rotate with the disc on which they are fixed, and then led over pulleys, thence through a perforated plate which forms the entrance to a tube passing through a chamber containing the covering material. The tube is perforated to allow the material when hot to pass freely into the interior. The exit of the tube is formed of two plates, or plate and tube to lay the strand. The first plate is perforated in the same way as the entrance plate to the perforated tube, viz., so that the wires pass each through its own hole; but the second plate has but one hole, and the wires being now covered with the material they are rendered quite solid. They are then, after being slightly twisted by hand, passed into a tube leading to the nozzle of the covering machine. Passing through a screw communicating with the gutta percha chamber this screw rotates by the motion of the tube of which it is a part. This tube is connected at its other end with the tube before described through which the wires pass. By reason of this rotation the strand finds no stationary point until it is received at the end of the water trough. To facilitate the rotation and add to the lay the inventor makes use of a frame with friction pulleys described in a former specification. Thus the strand is not laid until the wire, with its covering in a sufficiently solidified state, has passed the point of pull. Several other arrangements are also described. For the material the inventor finds that the following is the best composition, the proportions varying according to time of year, &c.: ozokerit, 10 parts; pitch, resin, or gutta percha, 5 parts, Venice turpentine, 5 to 10 parts.

3420. APPARATUS FOR TRANSMITTING SOUNDS, *G. F. R. von Wreden.—Dated 23rd August*, 1880. 6*d*.

The principle of the construction of the instrument is that of the microphone. In the figures, T is a stretcher membrane, K K¹ pieces of carbon, K being fixed to T, K¹ to a thick ring, R, on the contact regulator H. K is in electrical contact



with screw S, K¹ is similarly connected to S¹. G is a counterweight whose position regulates the pressure between the carbons. The inventor claims the arrangement as shown.

3424. IMPROVEMENTS IN ELECTRIC CONDUCTORS AND IN A COMPOUND FOR PREVENTING THE DETERIORATION OF RUBBER INSULATORS, *G. Barker.—Dated 24th August*, 1880. — (*A communication from W. W. Jacques.*) 4*d*.

The inventor impregnates the pores of the rubber insulator with a mixture of equal parts of Venice turpentine and beeswax. He takes a vessel with preserving compound in it, heated to about 80 deg. C., the rubber being added in the form of sheets; the heat is then raised to about 100 deg. C., and the air gradually exhausted from the vessel and also from the pores of the rubber. The air is then admitted, the mass cooled to 80 deg. C., and the rubber removed; it is then mixed on warm rolls in usual way with powdered sulphur, and with an equal weight of steatite or asphalte to give it bulk.

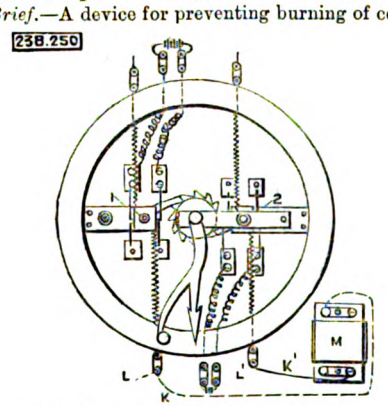
237,971. COMBINED TELEPHONE AND AUTOMATIC SWITCH, *Ezra T. Gilliland, Indianapolis, Ind., assignor to the American Bell Telephone Company, Boston, Mass.—Filed September 6th*, 1880.

Brief.—Two telephone posts are separated by an insulating material or space, and on the inside of each post is a V-shaped notch, forming a square recess, in which a ball of conducting material is placed. When the telephone is in a vertical position the ball rolls down against both posts and connects the circuit. When the instrument is raised into a horizontal position for use the ball falls into the notch in one post or the other, and the circuit goes through the telephone. *Claim.*—(1) In combination with a telephone, two posts or parts formed with cavities in their adjacent faces,

and a ball which is inserted in said cavities, said cavities having a formation, substantially as described, by which said ball is caused to establish an electrical connection between said parts when the telephone is in one position, and to break said connection when it is in other positions, substantially as and for the purposes set forth. (2) The combination of the telephone, the parts B B, divided by space or insulating material, as described, and the ball D, resting in a chamber or cavities formed in said parts, substantially as and for the purposes set forth.

238,250. TELEGRAPH MECHANISM, *Samuel M. Plush, Philadelphia, Pa., assignor to himself and William P. Phelps, same place.—Filed September 15th*, 1880.

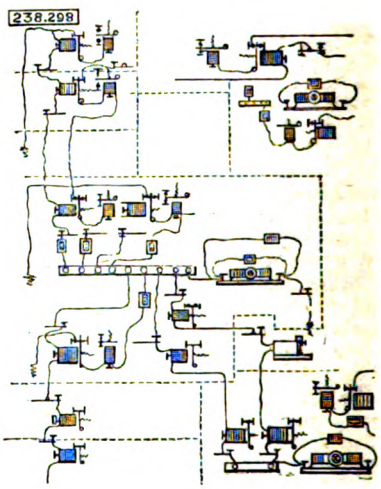
Brief.—A device for preventing burning of con-



tact points in pole changers. A condenser is arranged in circuit so as to neutralise heating effect due to spark by discharge on reversal of poles. *Claim.*—(1) In combination with pole changers, No. 1 and No. 2, the single condenser, M, two line wires, L L′, and condenser wires, K K′, all connected and operating substantially as and for the purposes described. (2) The combination, with two line wires, L and L¹, the circuits in which are broken simultaneously, of single condenser M, and condenser wires K K¹, the said two condenser wires being connected to the opposite ends of the condenser, substantially as and for the purposes described.

238,298. DYNAMO-ELECTRIC TELEGRAPH, *Orazio Lugo, New York, N.Y.—Filed December 20th*, 1880.

Claim.—(1) The combination, substantilaly as hereinbefore set forth, of a dynamo-electric generator, a constantly-closed shunt circuit connecting the opposite poles of said generator, two parallel lines or circuits connected to the said generator in multiple arc with each other and with the said closed shunt circuit, two or more relays having their helices included in one of said parallel circuits, and their circuit breaking devices in the other parallel circuit, and one or more signalling keys in each of said parallel circuits. (2) The combination, substantially as hereinbefore set forth, in a dynamo-electric generator, of a revolving armature coil and a stationary field magnet, both of which are included in the same circuit with the exterior resistance, two or more independent shunt



circuits, which connect the opposite poles of the generator with each other, and thereby act to keep the circuit of the armature and field magnet continuously closed irrespective of the condition of the exterior or working circuits, and means for adjusting or regulating the resistance of said shunt circuits with reference to each other. (3) The combination, substantially as hereinbefore set forth, of a dynamo-electric generator, a constantly-closed shunt circuit connecting the opposite poles of said generator, one or more main lines extending from one pole of said generator to one or more distant stations, and a commutator, whereby the opposite pole of said generator may be connected to the earth either with or without an interposed resistance, or to another main line leading to another distant station.

IMPORTANT TO TELEGRAPH COMPANIES.

THE SANITAS COMPANY (Limited), of Bethnal Green, E., have received the following gratifying letters upon the subject of Sanitas and its uses at Foreign Telegraph Stations:—

"THE MANAGING DIRECTOR, THE SANITAS COMPANY (LIMITED). "February 4th, 1880.

"We have now for more than a year been using your SANITAS soap and disinfectants in our ships, as well as at our stations, and find it greatly appreciated, more especially at tropical places, where the importance of sanitary arrangements is not well understood."

"London, 15th November, 1880.

"I think it right to inform you that our Superintendent at Mozambique says:—'I use the much-prized "SANITAS" freely, and feel perfectly safe wherever I sprinkle it.' "JAMES ANDERSON, Managing Director, Eastern Telegraph Company (Limited), 66, Old Broad-street, E.C."

"SANITAS" DISINFECTING FLUID, No. 1, in 1/- and 2/6 bottles.
"SANITAS" DISINFECTING FLUID, No. 2, in 1/- pints.
"SANITAS" DISINFECTING OIL, @ 30 - per gallon.
"SANITAS" TOILET FLUID, in 1/- and 2/6 bottles.
"SANITAS" DISINFECTING POWDER, in 1/- boxes, and 17/6 per cwt.
"SANITAS" TOILET and NURSERY POWDER, in 1/- boxes.
"SANITAS" TOOTH POWDER, in 1/- boxes.

"SANITAS" DISINFECTING HARD SOAP, No. 1, in 6d. bars.
"SANITAS" DISINFECTING HARD SOAP, No. 2, in 4d. bars.
"SANITAS" SOFT SOAP, in 1/-, 1/9, 3/-, 5/-, 9/-, 12/6, and 24/- sizes.
"SANITAS" TOILET SOAP, in 1/6 boxes of three tablets.
"SANITAS" DISINFECTING FURNITURE CREAM, in 1/- bottles.
"SANITAS" DISINFECTING OINTMENT, in 1/- and 3/6 sizes.
"SANITAS" VETERINARY OINTMENT, in 2/6 tins.

SANITAS is Non-Poisonous and Without Stain, and is used by 400 Public Bodies.

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INSTITUTION OF CIVIL ENGINEERS.

In the speeches at the annual dinner of the members of this Institution on Saturday last some interesting references were made to the social and political changes wrought by the extension of telegraphic communication, mainly due to the skill and enterprise of the engineering profession. Earl Kimberley said :—"I suppose that nothing tends so much to change the political aspect of the world as the extension of telegraphic communication and the construction of railways all over the civilised world which we have witnessed in the present century. These great works have done more to alter the condition of society throughout Europe, and they are now beginning to alter it throughout the world, than any war or any political event which has taken place during that period. No one can anticipate the effect of the constant communication of one country with another; for there is a tendency to produce uniformity of thought, of habit, and of conduct; and whatever takes place in one part of the world affects, not slowly, but immediately, all nations and societies. It is beyond the power of man to forecast the remarkable effect which this swift intercommunication of feeling and sentiment may have in course of time; but I am certain that it portends changes of which we have no idea, and that the social condition of the world will be altered in a manner which we cannot foresee." The American Minister, Mr. Russell Lowell, also spoke in a similar strain. "Though I am wanting," said he, "in sympathy for some of the achievements of modern science, yet I must confess that you are the makers and masters of the modern world so far as it is visible, palpable, and serviceable to the rest of us. The noble lord (Kimberley) who answered for Her Majesty's Ministers alluded to the power of the telegraph, and in a perfectly true sense you have succeeded to a mission which has something sacred in it. You have realised the dream of the poet of two centuries ago in annihilating time and space, so that when I send a message to America, I do what was formerly thought to be impossible. I think there is no achievement of modern times which so touches the imagination as that narrow bridge for thought which engineering skill has enabled us to carry through the profound and silent stretches of the Atlantic from this continent to the other. The modern engineer seems to have realised the dream of the ancient philosopher that the earth is a sentient being. It has made mankind contemporaries in a sense they never were before. That horrible event which happened the other day at St. Petersburg was felt all over the world in a single thrill, all through the triumphs of modern engineering; and though the skill and ingenuity of the engineer are devoted sometimes to the service of war, yet they may tend really to the furtherance of peace, because as you make war more effective for the purpose of destruction, you render men more reluctant to enter upon it as it becomes more costly. You also render it less picturesque. The warfare of the ocean has lost almost all the beauty which formerly belonged to it, and seemed to throw a kind of poetry over it. We owe that, I think, to the inventions, or the application of inventions, by the genius of engineers."

TRAFFIC RECEIPTS FOR MARCH, 1881.

Companies.	March, 1881.	March, 1880.	Increse.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	3,100 estd.	3,586	—	486
Direct Spanish Telegraph Company	1,492	—	—	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	51,206	43,374	7,832	—
Eastern Extension Telegraph Company	29,661	26,425	3,236	—
Great Northern Telegraph Company	18,520	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company.	—	—	—	—

TELEGRAPH SHARE LIST.

Companies.	Closing Prices April 6.		Business Done Week Ending April 6. Highest.	Lowest.
Anglo-American	57½,	8	52¾	56¾
Do. Preferred	86½,	7	87¼	86½
Do. Deferred	29½,	30	30¼	29¼
Brazil Submarine	10½,	¼	10¼	10⅜
Cuba	8½,	9½	—	—
Do. Preference	16½,	¾	16½	16¾
Direct Spanish	3½,	4½	—	—
Do. Preference	14,	15	14¾	14½
Direct United States Cable	10½,	11	11¼	10½
Eastern Telegraph	9½,	10	9 15-16	9¾
Do. 6 per Cent. Preference	12¾,	13	12¾	12¾
Do. 5 per Cent. Debentures, 1899	102,	104	—	—
Eastern Extension	10 7-16,	9-16	10½	10½
German Union	11½,	¾	11¼	11½
Globe Telegraph and Trust Company	6½,	¾	6 7-16	6½
Do. Preference	12½,	¼	12½	12½
Great Northern	12½,	¼	12½	12½
Indo-European	27,	28	26½	26½
Mediterranean Extension	2½,	¾	2¾	2¾
Do. Preference	10,	¼	10	10
Reuter's	10½,	11½	—	—
Submarine	270,	280	282½	280½
West India and Panama	2½,	¼	2 3-16	1 9-16
Do. 1st Preference	7½,	¼	7¼	7
Western Brazilian	8½,	¾	9	8¼
West. Union 7 per Cent. 1st Mortgage	122,	127	—	—
Do. 6 per Cent. Sterling Bonds	101,	104	—	—

In the matter of the Companies Acts, 1862 and 1867, and in the matter of the EDISON TELEPHONE COMPANY of LONDON (Limited).

THE CREDITORS of the above-named Company are required, on or before the 25th day of April, 1881, to SEND their NAMES and ADDRESSES and the PARTICULARS of their DEBTS or CLAIMS, and the names and addresses of their solicitors if any, to SAMUEL LOWELL PRICE, of 44, Gresham-street, in the City of London, the Official Liquidator of the said Company, and if so required by notice in writing from the said Official Liquidator are by their solicitors to come in and prove their said debts or claims at the Chambers of the Master of the Rolls, Rolls-yard, Chancery-lane, in the County of Middlesex, at such time as shall be specified in such notice, or in default thereof they will be excluded from the benefit of any distribution made before such debts are proved.

Monday, the 9th day of May, 1881, at 11 o'clock in the forenoon, at the said Chambers, is appointed for hearing and adjudicating upon the debts and claims.

Dated this 24th day of March, 1881.

C. BURNEY, Chief clerk.

Freshfields and Williams,
5, Bank-buildings, London,
Solicitors for the Official Liquidator.

ROOT'S PATENT STEAM BOILERS, FEED WATER HEATERS, SUPERHEATERS, &c.; also KNAP'S MECHANICAL STOKERS.—WANTED GENTLEMEN with influential connection to ASSIST in the SALE of above. Remuneration by commission. Reference to many eminent firms, both in London and provinces, who having adopted are now re-ordering year after year.—Address, The PATENT STEAM BOILER COMPANY, 117, Palmerston-buildings, E.C.

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BIRKBECK BANK.—Southampton Buildings, Chancery Lane.

Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

Letters of Credit and Circular Notes issued.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

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VULCANISED FIBRE (Patented).

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Metals, Hard Wood, Ivory, Vulcanite, Ebony, &c.,

And is extensively used by ELECTRICIANS as an INSULATOR.

Sold in Sheets 3ft. 6in by 5ft. 6in., from one-fiftieth to an inch in thickness, at 2s. 3d. per lb.

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HARBURG-ON-ELBE.

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GUTTA PERCHA INSULATED TELEGRAPH WIRE.

Also Covered with Silk or Cotton, Taped or Braided.

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Manufactory—101 and 102, ST. MARTIN'S LANE, W.C.

MAKERS OF ALL KINDS OF

Electrical Test, Mathematical, Physical, and other

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Experience, accumulated since the time of Benjamin Franklin, proves conclusively that a Conductor made of Copper, of adequate size, is the best of all appliances for the protection of every description of Building from the destructive effects of Lightning.

NEWALL & CO.'S PATENT COPPER-ROPE LIGHTNING CONDUCTOR,

As applied to all kinds of Buildings and Shipping in all parts of the world with unvarying success, is the most reliable, most effective, and cheapest conductor offered to the public. It is simple in its application, no insulators being required; and it costs only ONE SHILLING per foot for the standard size, which is safe in any storm.

SOLE PATENTEES OF UNTWISTED WIRE ROPE.

Manufacturers of Iron and Steel Ropes for Colliery and Railway purposes. Rigging Ropes, Guide Ropes, &c.

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LIVERPOOL—36, Waterloo Road. GLASGOW—68, Anderston Quay. Manufactory—GATESHEAD-ON-TYNE.

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W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.
Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.
All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.
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BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

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Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

NORTHERN FIRE and LIFE ASSURANCE COMPANY.
Established 1836.
Head offices—Aberdeen and London.

Subscribed Capital	£3,000,000
Of which paid up	300,000
Fire Reserve Funds	637,977
Life Funds, as per last account	£1,462,146

LONDON BOARD of DIRECTORS.
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12mo., sewed, 6d., cloth, 1s.

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London: E. and F. N. SPON, 16, Charing-cross; New York, 446, Broome-street.

ELECTRIC LIGHT.—Advertiser, an Englishman, who has had great experience in public and private lighting, and illuminations abroad, is OPEN to TREAT with inventors and companies for the introduction and working of their patents or systems in Italy. Address,
JAMES SHEPHERD,
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THE "JAMIN" PATENT ELECTRIC LIGHT,
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Capital 8,000,000 francs.
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J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

NOTICE OF REMOVAL.

EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
3, BEDFORD COURT, COVENT GARDEN, W.C.,
Will on and after the 1st May, 1880, REMOVE to
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C
The Gower-Bell Loud Speaking Telephone.
TELEPHONE LINES ERECTED and MAINTAINED
EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.
Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

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SLIP

BRAZIL.—The Pernambuco and Para cable is interrupted.

PERSONAL.—Professor W. E. Ayrton and Dr. Alder Wright are to be elected Fellows of the Royal Society in June next.

COLOGNE CATHEDRAL BY ELECTRIC LIGHT.—The dome of this magnificent building is illuminated both outside and inside by the Siemens light.

THE FIRST ATLANTIC CABLE COMPANY.—The 10th of March last was the twenty-seventh anniversary of the organisation of the first Atlantic company.—*Operator.*

INTERNATIONAL ELECTRICAL EXHIBITION.—It is reported that the credit of 25,000 francs asked for by M. Berger in connection with the exhibition will be willingly accorded.

NEW YORK ELECTRICAL SOCIETY.—The third meeting of this society was held recently, when the organisation of the society was proceeded with. The number of members is about 200.

HOLLAND AND THE TELEPHONE. — The Netherlands Goverment are establishing telephone lines in the small communes, where the erection of a telegraph office would be too costly.

THE TELEPHONE AT BRUSSELS.—Recent experiments with the telephone between Brussels and Liege were very successful. Communication was carried on between the two towns with great ease.

ELECTRIC LIGHT AT THE BUILDING EXHIBITION.—Messrs. Wells and Co. are exhibiting the Jablochkoff system of electric lighting at their stalls at the above exhibition in the Agricultural Hall.

FRENCH PHYSICAL SOCIETY.—At a recent meeting of this society M. Baillehache described his dial-printing telegraph. The manipulator is so constructed that the current is alternated at each letter that is sent.

ELECTROLYSIS.—Mr. E. F. Smith finds that a black hydrated oxide, $Ur_3 O_4$, is precipitated when a galvanic current is passed through a solution of uranium acetate, formate, or nitrate.—*Journal of the Chemical Society.*

A NARROW ESCAPE.—During a garden party at Government House, Lahore (India), a tree close to the midst of the guests was struck by lightning, but no one was injured. Hailstones which fell at the time are said to have been as large as pigeon's eggs.

ELECTRIC LIGHTING FOR THEATRES.—Roused by the recent lamentable accident at Nice, the question of introducing the electric light into theatres instead of gas is the subject of a good deal of discussion amongst our neighbours on the other side the Channel just now.

SS. "RETRIEVER" AND "CHILTERN."—The Eastern Telegraph Company's cable ship "Retriever" is connecting some more of the Greek islands with the mainland, and the "Chiltern" is engaged connecting the Lipari islands with Sicily for the Italian Government.

SWAN'S LAMP AT NEWCASTLE.—For the last few nights one of the principal streets in Newcastle has been illuminated by means of Swan's electric lamps. The light is reported as being of a pure steady white, pleasant to the eye, and diffusing a clear glow around the spot on which it is placed.

INDO-EUROPEAN TELEGRAPH.—The directors of the Indo-European Telegraph Company (Limited) recommend a dividend for the second half of last year of 17s. 6d. per share, making 6 per cent. for the year. A bonus of 10s. is also recommended, and £7,500 is to be placed to the reserve fund.

ELECTRIC LIGHT FOR ONTARIO, CANADA.—A scheme for lighting Ottawa with the electric light has been submitted to the Municipality, and experiments are to be commenced forthwith. It is also reported that the Edison Electric Light Company have selected Toronto as one of the cities for laying down wires.

ELECTRIC LIGHT AT BORDEAUX.—The large theatre was recently illuminated by the Debrun electric lamp, on the occasion of a ball in aid of a charity, given by the Freemasons. Despite some interruptions, owing to the temporary nature of the installation, the light is said to have been very satisfactory.

MORE EARTHQUAKES.—A Reuter's telegram, dated New York, April 11, says:—"A violent shock of earthquake was felt at 2 o'clock yesterday morning throughout the centre of California." Another telegram, dated Tuesday, April 12, says that a severe shock took place at the port of Pola, Austria, at a quarter to 10 a.m. on that day.

PRICES.—The prices as quoted are:—For gutta percha per lb. genuine, 4d. to 3s. 3d., reboiled 3d. to 1s. 3d., and for india rubber, per lb., Para (fine) 3s. 6½d., negrohead 2s. 5d., Central American 1s. 11d. to 2s. 6d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d. The market is reported as very quiet.

THE TELEGRAPH CONSOLIDATION AND THE YANKEE PRESS.—American newspapers wax facetious over the telegraph consolidation. One says that the colour of the new telegraph stock should be old Gould, another suggests Green, a third thinks they should be printed on the press that Vander-bilt, whilst a fourth Sage-ly says these are Keene witticisms. That Bates all.

A POWERFUL LAMP.—The Brush Electric Light Company have constructed a lamp of 100,000 candle-power, which was successfully tested last month at their manufactory in Cleveland, U.S.A. This is the largest and most powerful lamp that has hitherto been made, and is we believe intended for use in our navy. The carbons are two-and-a-half inches in diameter, and the motive power required is 40 h.-p.

BOERISH BEHAVIOUR.—A Reuter's telegram of 10th April says:—"It is asserted that the Boers refuse to allow the reconstruction of the telegraph lines beyond Coldstream." Later information, dated from Pietermaritzburg, says:—"The inspector engaged in the reconstruction of the Transvaal telegraph lines has been threatened by the Boers, and ordered back with his men and materials. They are decidedly opposed to telegraphic communications."

EXPERIMENTS ON MAGNETIC COERCITIVE FORCE.—Dr. Kulp magnetises iron and steel rods in spirals, which he opens before taking out the rods. On percussion the permanent magnetism of the rods is partly increased, partly diminished, and partly inverted. A series of induced currents arise in the rods on opening the spiral, which is explained by their having been exposed to magnetising forces in alternating directions.—*Wiedemann's Bieblätter.*

"WHAT KEEPS THIS FRAME GOING?"—Such is reported as the exclamation of Dr. Tanner to an Indianopolis Journal correspondent. "Electricity! that's what does it. We are run by lighting, and Edison might profitably make some experiments on it. I believe that I was kept alive for those forty days by the electricity obtained from the air and the water. I claim that it is electricity that runs this machine, and I am willing to stake the machine on the correctness of my theory."

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THROWING THE HATCHET.—Lord Kimberley, the Colonial Secretary, informed the members of the Institute of Civil Engineers, at their banquet the other evening, that we owe the peaceful attitude of the King of Ashantee to the mere apparition of a telegraph wire. His Highness sent his warlike message in the usual shape of a golden hatchet; but directly he saw the English erecting their telegraph wire in anticipation of a campaign he became so terrified that he protested his hatchet meant nothing at all—was, in fact, a playful bit of bounce. May his blissful ignorance never grow wiser.

THE TELEPHONE AND THE OPERA IN PARIS.—During a recent representation of an opera in Paris powerful microphones were placed in front of the stage, which were connected with Ader receivers placed in a distant room. The results were splendid, the modulations of the solo voice, and the chorus, being equally well heard. *La Nature* says that this experiment is to be repeated during the time of the exhibition. There is to be a room in the Palais de l'Industrie, in the Champs Elysées, where anyone may listen to the music of the opera which may happen to be performed that evening.

FESTIVITIES.—The *Operator* describes the seventh annual ball of the Chicago operators, which took place in February last. It seems to have been a very grand affair. In front of the orchestra was a perfumery fountain, which is said to have been much sought after during the evening. The toilets of the ladies are spoken of as being very rich and beautiful, and some local beauties are pointed out as deserving special mention. Altogether, the Chicago operators seem to have had an uncommonly pleasant time of it. It is needless to add that a capital supper was discussed, at which the local mayor presided.

GAS V. ELECTRICITY.—The following news reaches us from America:—Owing to an increase of nearly 65 per cent. in the gas bills of the White Star Steamship Line (which is attributed to the bad quality of the gas), General Agent R. J. Cortis has adopted the United States Electric Light system for use on Pier No. 52, North River, New York. In addition to using this light on the pier, it is proposed to use it in the holds of the White Star steamers while loading and discharging, thus avoiding the risks and inconvenience of gas or kerosene. Mr. Cortis believes that the saving will be at least 100 dollars a month, or 33 per cent.

ANOTHER ELECTRIC LIGHT COMPANY. — The *New York Engineering News* says: — "Mr. John Caldwell, of the Westinghouse Air Brake Company, Mr. C. L. Magee, and others are said to have entered into arrangements for the organisation of a company for lighting the streets, public buildings, and manufactories of Pittsburgh with electric light. The machines of the Brush Company of Cleveland will be used, with the addition of an improved motor invented by Mr. George Westinghouse, which overcomes the frictional forces more readily than the machines generally used. It will require three or four generators to furnish light for the City, and the street lights will be arranged at such distances as to make the light visible through the usual fog."

QUICK WORK IN OCEAN TELEGRAPHY.—The New York papers are astonished, and well they may be. Here is what they say:—"There are few people who realise the great advance that has been made in the art of ocean telegraphy, or who have an adequate idea of its perfection. A case in point is the Cambridge and Oxford Boat Race. The National Associated Press despatch giving the result was transmitted from the point of the finish to the London agent's office, and filed with the Direct United States Cable Company, who transmitted it to New York in twenty-seven seconds. This, perhaps, is the quickest time ever made by any cable company, and, as such, is worthy of note. The Direct United States Cable Company is well deserving of the universal popularity it has earned."

SUB-DIVISION OF THE ELECTRIC LIGHT.—At the invitation of Mr. J. B. Rogers a number of electricians assembled, on Wednesday afternoon, the 6th April, at his laboratory, St. Clement's-house, Lombard-street, to witness some experiments with his process for the division and sub-division of the electric current, so that the electric light may be available for dwelling-houses, &c. Mr. Rogers claims that by a good and economical machine, and one thoroughly trustworthy for steadiness of motion, he has solved the problem of dividing the electric current. This is given out through the apparatus in any required direction, and is very evenly distributed, a great advantage claimed for it being that lights can be connected or disconnected in any particular circuit without disarranging all or any of the others.

THE USE OF THE TELEPHONE.—The following correspondence over the telephone wires yesterday, says the Kansas City *Times*, is a further proof of the fact that no one but a bald-headed man could do without one:—"Hello, central!" "Hello!" "Connect me with the signal bureau." "All right—go ahead." "Hello, signal!" "Hello!" "Is it going to thaw to-day?" "Yes, there are indications." "How's the wind?" "Getting round to the south." "Do you think I can safely have my hair cut?" "Wait a minute until I consult the barometer, thermometer, and wind gauge." (Silence for half a minute.) "Hello!" "Hello!" "Yes, you can go ahead. There won't be any change to speak of for the next twelve hours. There is a cold wave moving up the Ohio River, and a snow-storm is reported at Cheyenne, but if I were you I'd take my chances on the hair cutting." "All right—much obliged." "Good bye."

AN IMPROVED SUPPORT FOR WIRES.—The *Scientific American* gives an engraving and description of an elevated support for telephone and telegraph wires, invented by Mr. T. G. Ellsworth, manager of the John-street office of the Metropolitan Telephone and Telegraph Company, New York. The invention is in the form of a tubular structure, supported by posts similar to ordinary lamp posts. Inside this tube are arranged a number of shelves for supporting the cables, which are marked at suitable distances along the route in the covering. At each street crossing is located an electric light, its support being a part of the structure. At proper distances are placed letter boxes, arranged for the attachment of a pneumatic tube for collecting the letters, or they may be collected in the usual way. Electric clocks are also placed where desired. Police time detectors, fire alarm boxes, and ambulance boxes for calling ambulances, form part of the inventor's scheme. The supporting columns being hollow admit of cables passing underground to offices.

LEGAL.—EDISON TELEPHONE COMPANY.—On Tuesday, the 2nd April, the case of the Attorney-General *v.* the above company was heard before Mr. Justice Denman and Mr. Baron Pollock. The Attorney-General mentioned the case to the Court, and stated that since the issuing of the decree to restrain the defendants from continuing their business there had been negotiations between the Postmaster-General and the company, and he was glad to say that this had resulted in an arrangement which would put an end to the litigation. When once the claim of the Crown to the monopoly was admitted, they would be ready, in the interests of

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the public, to grant licenses, so that there might be no impediment to the active carrying on of telephonic communication. To carry out this agreement, however, it would be necessary to have the decree varied, and his present application was that their lordships would sanction the necessary variation. He further said that the application was made with the sanction of all the parties who were interested in the matter. The application was granted.

Resignations among Telegraph Clerks.—According to the return obtained by Mr. Gray, M.P., of the number of telegraph clerks who have resigned since 1872, the numbers are as follow:—In England—males 1,192, females 636; Scotland—males 136, females 66; Ireland—males 159, females 54; total, 2,343; showing that about one-third of the staff left for more remunerative employment, or about one-half of those who had proved themselves to be efficient in the service. The return does not include deaths or dismissals. We are rather surprised at the lowness of the figures representing resignations among females. The number for England shows roughly for the eight years an average of 80 per annum, or less than seven a month. The metropolis alone would, we should have thought, have more than exceeded this average. On the other hand, as regards the males, the bulk of the resignations would appear to be at the provincial offices. In any case the drain upon the staff, as shown by this return, is very remarkable, and must be a source of considerable loss both in money and efficiency.

Electric Lighting in the City: its Cost.—In the district allotted to the Anglo-American Electric Light Company ("Brush"), comprising Blackfriars-bridge, New Bridge-street, Ludgate-circus, Ludgate-hill, St. Paul's Churchyard, and Cheapside (western end to King-street), 32 electric lamps, at a cost for the year of £1,410, are substituted for 150 gas lamps, costing annually about £650 (including lighting and cleaning), thus making the cost of the experiment in this district but £760 above the ordinary outlay for gas; but, deducting the cost (estimated at £750) of providing and fixing the electric machinery and lamps, and removing the same at the expiration of the contract, the expense, as near as possible, is the same as for gas. In the district comprising London-bridge, Queen-street, King-street, Poultry, Guildhall-yard, Mansion House-street, Royal Exchange, and King William-street, assigned to Messrs. Siemens Brothers, 32 electric lamps (including six large ones) will be employed in lieu of 138 gas lamps. The amount of this contract is £3,720. The sum saved by non-consumption of gas is about £600. The amount estimated for providing and removing the electric machinery and lamps at the expiration of the contract is £1,450, so that the cost, compared with gas, is 3 2-3 more.—*Citizen.*

A Baronetcy for Mr. Pender.—The *Carlisle Journal* says:—"A rumour is current that Mr. Pender, the member for Wick, is to have a baronetcy. Mr. Pender has done an immense amount of public service in the way of promoting submarine telegraphs, and if he had never done anything beyond the creation of the Cape cable, he would have a claim for honourable recognition from the Crown. It is impossible to over-estimate the value of this undertaking to the country during the past three months. It is not too much to say that, if there had not been means of communicating to London the news of the outbreak in the Transvaal, the Boers would have swarmed over the frontier, carrying all before them, far beyond Laing's Nek; and what was the revolt of a province might have proved the rebellion of the whole Dutch speaking race at the Cape. Since the Cape cable brought the news of the outbreak to London, hastening the despatch of reinforcements by the term of three weeks, it has been in hourly use by the Government, who have through it controlled all the operations at the Cape. Two years ago this would have been impossible, and it is entirely due to Mr Pender's personal energy and enterprise that the Government have been placed in this position of vantage." We hope this rumour may prove to be true.

From the Country.—Two addresses were delivered the other evening in St. John's schoolroom, Moulsham, under the auspices of the Chelmsford Mutual Improvement Society, on "The Past History, the Present State, and the Probable Future of the Electric Light." The lecturers were Messrs Lindberg and Sudworth, foremen of the electric department at Messrs. T. H. P. Dennis and Co.'s works, Chelmsford. The addresses were illustrated by experiments, and the room was lighted with electric light, the electricity being supplied by connection with Messrs. Dennis's works. Mr. Lindberg touched on all the points of interest in the history of the electric light. The discovery of electric light, he said, was made by Sir Humphrey Davy about eighty years ago. In 1866 the discovery was made which laid the foundation for the substitution of dynamo electric in place of the magneto-electric machines. Mr. Lindberg then gave a description of the composition and working of various arc lamps He also spoke at length upon Swan's incandescent lamp. Speaking of the probable future of electric lighting, Mr. Lindberg said that, judging from the progress made already, they might safely predict that in ten years' time they would have the incandescent electric lamp introduced into the hotels and larger shops in London and other towns, and halls and public places would be lit up by means of the electric arc light. Mr. Sudworth then read a paper on the progress of the electric light during the last year.

Electric Light at Brighton.—The borough surveyor has recently presented a report on the Siemens lights tried on the Parade, from which it appears that originally four lamps (each of 2,000 candle-power) were used at intervals of about seventy yards, but at this distance the light was more powerful than necessary under any circumstances; but when the distances were increased to 138, 154, and 190 yards, and the lanterns enclosing the lights filled with ground instead of plain glass, there was a marked improvement; the light being softer and more agreeable, yet still powerful enough to throw a distinct shadow at 200 yards. The Madeira-road, which was about 80ft. below the lanterns (running parallel with the Parade), the beach, and the foreshore were brilliantly illuminated down to low-water mark. Some idea of the respective illuminating powers is furnished by the statement that twenty electric lamps (which, if placed 200 yards apart, would illuminate the whole of the sea-frontage of the town) would render about 140 of the existing gas lamps unnecessary, and thus save about £500. The gas committee of this town, at the invitation of their chairman, paid a visit a day or two ago to London to view the electric lights in the city. What was the effect produced upon these gentlemen history, at present, does not say; but it may be well to put on record the fact that the unfortunate gentlemen, before going forth to behold their fate, were set down to an "excellent repast" at the Guildhall Tavern. No doubt even the electric light took a rosy hue after this.

Fire Alarms.—M. Bartelous of Brussels, in a paper recently read before the Syndical Union of that City, divides the systems for electrical announcement of fire into five groups. 1. Those in which alarm of fire can only be given by addressing a police or fire brigade station, electricity being merely used between such stations (as in Paris). 2. Those

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in which the telegraph system is extended to electric alarms, either requiring special management or acting automatically, and in the latter case either completely free to the public or only to be set in action by certain persons (these are general in Germany, and are also found in England and Holland). 3. Those in which an alarm of fire can be given without leaving the house, as in New York. 4. Local arrangements in which by means of thermometer alarms individuals are informed of the beginning of a fire in a building. 5. Systems in which electricity is not only used to transmit alarms of fire, but to aid the despatch of succour, as for instance in San Francisco, where the harness is dropped on the horses, the gate-bolts are drawn, the gates opened, &c., by electrical agency, and in 50 seconds the fire engine is ready to start. M. Bartelous produced statistics which showed that with the most perfected systems serious fires were reduced to 4 per cent.; with systems of telegraph lines, but without alarms, they reached 17 per cent.; while without telegraph offices they reached 27 per cent. He recommended that the telegraph offices now open be authorised to transmit alarms of fire free of cost to the sender, and that this use of the office be indicated by placards.

"Still Single!"—A wail from the *Journal of the Telegraph*:—

I stood by the "Blake Transmitter,"
For the telephone bell had rung,
And over the wire came a sound
As though a maiden sung
A musical tone quite familiar.
Her voice I had often heard,
For in answering daily telephone calls
We had interchanged many a word.

Have you never received a letter,
And paused ere breaking the seal,
As you thought, concerning the tidings,
What the contents might reveal?
Did not a longing possess you
To know what was really within?
And yet to avail of that knowledge,
You seemed in no haste to begin.

In some such manner I tarried
At the end of our telephone wire,
Then at last, mustering courage sufficient,
Began at once to enquire:
"Well, halloo!—well, what is wanted?"
This at least was all I could do;
When quick in return came the message
"Halloo! well, halloo-o! who are you?"

"Why, I am 'forty-eight,'" I responded,
"You called me a moment or two."
"Forty-eight," she repeated in answer,
"Well, surely I don't wish for you."
I was giving my telephone number,
As found on the company's page,
But I fear, from her hasty answer,
She thought I was giving my age.
Alas, that the blow came so sudden!
I received it bewildered, alone,
And the consciousness there dawned upon me,
I'm rejected by telephone.

Mr. Fawcett and the Telegraph Clerks.—The delegates who lately formed a deputation to Mr. Fawcett have sent him an answer to the circular addressed to them deprecating the "line of action" they have taken pending his decision upon their claims. After expressing their surprise and pain at the charges made against them, they proceed to say:—"We have looked through the reports of all the meetings at which members of the deputation were present and have failed to discover that in any single instance it was stated that 'information was asked from the telegraphists by anyone but the Postmaster-General.'" They admit that they misapprehended the conditions upon which the interview was granted. "We assumed," say the delegates, "that we should be allowed to defend the position taken up in the united petition. The adoption of another course caused some disappointment; but our complaints arose from the unexpected presence at the interview of officials who, to the exclusion of competent authorities of the Telegraph Department, were asked to give evidence on points on which they had, confessedly, no practical knowledge. Judging from the returns with which they were provided, they appeared to have received notice of the questions which would be raised, whereas we received no information of the kind, and were called upon to answer everything without time for reflection or reference. The excitement and uneasiness which supervened on the termination of the interview were, however, mainly attributable to the disparaging statements made by some of the officials present as to the nature and character of our work and the intelligence requisite for its proper performance." These officials are referred to as "gentlemen who from their training are believed to be incompetent to form a correct opinion upon the value of their (the clerks') services." No further action is contemplated pending Mr. Fawcett's decision, in the impartiality of which this document professes to have the utmost confidence. It is signed by the "Provincial Delegates" only.

The Celestials and the Telegraphs.—The following, taken from the *Chinese Illustrated News*, may be of interest in connection with our recent Notes on the extension of the telegraph in China:—"In 1873 the first telegraph in China was constructed from Shanghai to Woosung, 36 li in length. At Woosung it connects with two lines, one through India and the Red Sea to Europe; the other through Japan and Russia to Europe. This telegraph line was made by foreigners. In 1874 the Chinese constructed a line from Foochow city to the Anchorage, also about 36 li. Though foreigners took charge of its construction, the means were furnished entirely by the Chinese. When the difficulties arose in Formosa, it was proposed to construct a line from Amoy to Foochow, 450 li. Foreigners proposed to construct it and after thirty years to turn it over to the Chinese Government. The Governor-General agreed to this proposition. When ninety li had been constructed, the work was stopped on account of the depredations committed by the natives along the line. In 1875 the Governor-General invited the foreigners to repair the line, but when 150 li had been made the people arose against it, complaining that it destroyed the *fêng-shui*. The Governor-General yielded to the wishes of the people and stopped the work. In 1878 the material was taken to Formosa, and more than one hundred li were put up and operated by Chinese pupils, who had learned something of it from foreigners. We hear that a line has lately been constructed through several important places from the sea coast to the Governor's office, and is nearly completed, entirely by Chinese. The officers of the Fuhkien province have been very active in introducing the telegraph, and deserve much praise. We now hear that a line is to be constructed from Tientsin to Shanghai, and that the means are to be furnished by the confiscation of Ch'ung How's estates. It is said that the telegraph company in Shanghai have offered to import the material for the Chinese at cost price, in order to help on such an important improvement. Much of the material is said to have arrived, and Li Hung-chang has sent a deputy to Shanghai to take charge of the work. The introduction of this invention into China is the complete destruction (ripping up) of the old exclusive system." For the benefit of our readers we may explain that the Chinese measure, li, above alluded to, varies a good deal, but is generally taken to be about one-third of an English mile.

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PROFESSOR TYNDALL AT THE ROYAL INSTITUTION.

It is commonly understood that when Professor Tyndall is announced to lecture it is necessary to take a seat in good time, or take your chance of not obtaining a seat at all. Friday, the 8th of April, was no exception to the rule, for long ere the hand of the clock pointed to the hour of nine each seat was filled, and the announcement "Closed" affixed to most of the doors. The Royal Institution meetings are refreshing after the oft-times dull and weary "papers" of various learned societies, for here beauty and fashion go hand-in-hand with staid and sober science. Professor Tyndall seems able to interest all, for no signs of weariness can be detected during the lecture. On the 8th of April the subject itself was sufficient to enable an *habitué* to foretel an intellectual and experimental treat. It was the connection between radiant heat and sound.

The lecturer commenced by referring to the well-known fact that natural sources of energy can be transformed. Thus a steam-engine might do work in raising a weight to the top of the theatre, and the weight if let fall would generate an amount of heat equivalent to the work expended.

It was long thought that experiments with radiant heat upon gaseous matter would fail to give results, but Professor Tyndall has shown the inaccuracy of this idea more than thirty years ago.

Reference was made to the work of Rumford, Leslie, Melloni, &c., and Tyndall's method of experimenting on the absorptive action of gases with a Leslie tube was described. The tube used was polished in its interior, and critics had stated that the so-called absorption was really not due to absorption at all, but to a film collecting on the polished surface. Professor Tyndall explained that in answer to these critics experiments had been made with parallel rays of heat that did not impinge on the polished surface at all, and that the results showed that the gases under experiment were the cause of the absorption, and that the effect had nothing to do with reflection. Then the critics said the effect was caused by a film on the rock salt lenses, and Professor Tyndall proceeded to show how he met this criticism. If the effect is due to a film, then it will be the same whether the films be ·005in. or 50in. asunder, but experiment showed that the effect was observed when the lenses were close together, and the intermediate space saturated with the gas under experiment was different to that observed when the lenses were further apart and the intermediate space saturated with the gas.

If gases absorb radiant heat, then when the heat is absorbed there will be expansion, and when the heat is dissipated, a return to the normal volume. If these pulsations are intermittent, and occur quickly enough, they give rise to a musical note. The difference between the absorptive powers of different gases was shown experimentally. Those gases that absorb little heat give the least sound effect, those absorbing the greatest amount of heat give the greatest effect. Dry air absorbs little, and, therefore, when an intermittent beam of light is allowed to fall on a tube containing dry air little or no sound effect is produced, but if a little aqueous vapour be mixed with the air the sound effect is clear and distinct.

Professor Tyndall concluded his lecture by referring to the great difference between dry air and air more or less saturated by vapour, and hinted that the ancient tropical fauna and flora existing in these regions in geologic times might have been caused, not by the internal heat of the earth, but by a greatly different atmospheric condition than now holds—one that would allow of a greater quantity of the sun's heat passing to the earth, and at the same time prevent its being radiated.

THE GERMAN UNION TELEGRAPH AND TRUST COMPANY (LIMITED).

The tenth ordinary general meeting of the shareholders of this Company was held on the 12th inst., at the offices, Old Broad-street, under the presidency of Mr. Henry Weaver.

The SECRETARY (Mr. William Payton) read the notice convening the meeting, and the report of the directors, which has been published in *The Electrician*, was taken as read.

The CHAIRMAN stated that the condition of things was so highly satisfactory that there were really very few remarks for him to make, but there were one or two points to which he desired to draw attention. They would have seen that the balance sheet was made up for the eight months ending the 31st of December, 1880. They had done that in order to bring the accounts into the usual period of the year—namely, the 31st of December. They had found it better to do this, because the accounts of the parent company at Berlin were made up from the 1st of January to the 31st of December. Although this Company's accounts appeared to have been made up for the eight months they had got the full year's revenue—the two coupons, all the money earned by the parent company; but the expenses were made up for eight months for the purpose of bringing up the accounts to the 31st of December in each year. They had written off the balance of the expenses of the formation of the Company, amounting to about £130. The increase of traffic had been very marked, and had enabled the directors to declare the very satisfactory dividend of 7 per cent. The reserve fund, too, had been gradually increasing by 10 per cent. on the receipts, and now amounted to £15,615, and the renewal fund to £8,652, together making £24,268, or about one-seventh of the capital. The dividend, as they were aware, had been gradually increasing from year to year, and he really did not know any company which was in a more satisfactory condition than this one. They had a comparatively short cable, in very shallow water. In case of accident, the cable could be raised and mended; and although they had a tolerably satisfactory renewal fund—not a very great amount, but he thought fully enough for their wants—he did not know that they would ever have to renew the cable from end to end. They could pick it up should it ever be broken, and mend it, and therefore he really considered that the Company was in as satisfactory a condition as any which he had any experience of. It was not likely that the German Government would give another concession for laying a cable between Germany and this country, and therefore they were not likely to have the competition which existed upon other lines. The receipts were constantly growing, and the alterations in the tariff and the adoption of the word-rate had caused a very great increase, and he had no doubt that it would bring a very much greater increase in years to come. The parent company had for the first time been enabled to dispense with the 10 per cent. rebate which the Anglo-American Company gave it by agreement on its American traffic when it required it. In reality the parent company had paid 10 per cent., although this Company paid only 7, but the reason for that was that this Company, being formed on the basis of the old company, two £10 shares were given for one £15 certificate, and the apparent difference in the dividend was explained by that fact. He regretted that Sir James Anderson was unable to be present, through the illness of his wife, which had rendered it necessary for Sir James to go to Scotland. He concluded by moving the adoption of the report and accounts, and the declaration of a dividend, payable that day, of 8s. 3d. per share, free of income-tax, making, with the previous distribution in January of 5s. 9d. per share, a total dividend of 14s. per share, or at the rate of 7 per cent. per annum.

Mr. H. G. ERICHSEN seconded the motion.

Mr. DRAGE asked what was the period of the concession.

The CHAIRMAN: Twenty-five years from the date it was granted.

Mr. THOMAS WILSON observed that there were 2,170 shares unissued, and he asked whether there was any present intention of issuing them.

The CHAIRMAN, in replying, stated that if any of the certificates were offered for exchange they would be bound to exchange them, and the shares referred to were kept in reserve for that purpose.

Mr. WILSON asked if they had still the same arrangements with the Submarine Company.

The CHAIRMAN: Precisely the same, and they would last for the full term of the concession.

Mr. WILSON: You have only one cable?

The CHAIRMAN: They had only one cable, but it had four wires in it, three of which were occupied with German and Austrian traffic, and one with traffic to America. March, 1869, was the date of the concession.

Mr. CAMPBELL stated that reference had been made to the reserve and renewal funds. Did they appear in the accounts of the parent company?

The CHAIRMAN replied in the affirmative, and stated that any shareholder could have a copy of the accounts of the parent company. He then put the motion, and it was carried unanimously. Continuing, he moved the re-election of Count Oscar Reichenbach as a director of the Company.

Mr. ERICHSEN seconded the motion, and it was carried unanimously.

On the motion of Mr. Campbell, seconded by Mr. Drage, the auditor, Mr. Henry Dever, was re-elected.

Dr. SAUL observed that they had received a very satisfactory account of the Company from the chairman, and from the report which had been presented to them. There was one thing which struck him, and that was that, considering the efficient state of the Company, the directors were insufficiently paid. He saw from the eight months' statement of accounts that the remuneration of the four directors was £200 a year, and he thought as the Company was in such a satisfactory condition and paying a good per centage that the directors' remuneration should be increased. He therefore moved "That the remuneration of the directors for the year ending the 31st of December, 1881, and in future, be at the rate of £300 per annum."

Mr. HARKER seconded the motion, and it was carried unanimously.

The CHAIRMAN, in acknowledgment, said he thought there could be no better mark of approval than a vote of confidence in the directors such as that just passed, especially when it was accompanied by an increase in their remuneration. He was sure that his brother directors and himself were very much pleased that the shareholders should approve of the directors' labours on behalf of the Company. He must say that this was about the most successful telegraph company they had [a voice, "Except the Submarine"]. The Submarine Company was very much larger; they had a very much larger undertaking, and a Government contract which no other company had ever enjoyed. It was an exceptionally good concern. The directors were very much obliged to the shareholders, and they would do all that they could to merit their future approval. He thought that on the present occasion the attendance was the largest they had ever had, and he should be glad to see the shareholders in future evince their interest in the concern in the same manner, by attending the meetings of the Company, though their absence showed their confidence in the directors, which, of course, was very gratifying to them. Replying to a question, he added that there was no doubt that they could do a much larger business than they did; but they were bound by their agreements. Their agreement with the Submarine Company gave them 25 per cent. of the traffic of Germany for the time of their concession. Their position was pretty well secured by this agreement, but they only shared in that amount of percentage of the increase in the traffic. This, however, was a very large increase, and it was likely to be. They hoped that the present year would show as large an increase as the last.

The proceedings then terminated.

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THE ELECTRICIAN.

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THE UNITY OF TELEPHONE INTERESTS.

Every schoolboy knows how the old fable of the bundle of sticks proves that "unity is strength." It seems that the proprietors of the various systems of telephone exchanges have at length understood this, and that they are approaching that phase of their existence when disorder takes refuge in union. Ever since the wondrously simple instrument of Professor Bell has been before the commercial world as an appliance to be used and not merely looked at as a scientific toy, litigation has been carried on between the friends of rival systems. It was clear to men of science from the first that for practical purposes Bell's instrument needed improvement, and that it could not arrogate to itself the sole right to act as receiver and sender. Edison invented several forms of telephonic apparatus which were claimed to be superior for certain purposes to those of Bell. The conclusion arrived at by the public compelled the Edison-Bell interest to coalesce. The combined instrument was obviously better than either separately. Hence the United Telephone Company was promoted, and the rivals became friends. Meanwhile, in England, an Act of Parliament had placed in the hands of the Postal Telegraph Department the sole right to provide telephonic communication. The question was tried at length in a court of law, and was decided against the companies. So far as we can gather, the postal telegraph authorities have always been willing to make arrangements for facilitating telephonic communication; and, whilst keeping in view their undoubted rights, have not in their final settlement hampered the work of the telephone companies. Thus, we see the Bell, Edison, and Government interests united. There still remained one other active company to conciliate. The invention of the microphone by Professor Hughes gave telephony another instrument wherewith to deal, and many attempts were made to contrive a workable combination of microphone and telephone. Mr. Gower succeeded in his attempts, and fair competition has shown that his instrument is equal (the majority of users say it is far superior) to the Edison, or Bell, or combined Edison-Bell instruments.

We must digress here to record a fact which ought always to be remembered—that the discoverer of the microphone gave it freely to the world, and that he reaps no pecuniary benefit from it, whilst the application of that discovery seems destined to bring much profit to those who have utilised it.

The latest announcement tells us that the Gower interests have effected a junction with the rival interests, and we have now a complete unity of telephone interests. How will this unity of agreement affect the interests of the public is a question that should, without loss of time, receive consideration. A little thought will show that rival telephone exchanges cannot be tolerated in one town. The value of these systems depends on the numbers accommodated, and if several exchanges existed side by side in competition, A having joined one, while B has joined another, telephonic intercourse between A and B would remain impossible. The conveniences of telephonic exchanges would be forgotten in the petty annoyances that would arise from this state of things. In twenty cases the exchange patronised by A might give him all he required, and fail only in the twenty-first; nevertheless, the one failure would impress itself more vividly on the mind than the twenty successes. The conclusion we must deduce from a complete argument of the question would be that there can be no competition in any given place, but that there must be a monopoly.

Suppose this is admitted. The question arises whether monopoly does not mean paying too high a price for what we get, and giving too much power into the hands of a company. It must, however, be understood that the monopoly is not absolute, but may be termed one of condition—a monopoly, in fact, just so long as public convenience is considered, and no extortion exercised. If the promoters of an exchange in any town are too grasping, their concessions from the municipal authorities would be imperilled, and, as success depends entirely upon the numbers joining such exchange, any wide-spread dissatisfaction can easily make itself felt through that channel. Then, again, the Government does not give up its right to supply the public, and should at any time a majority in the country show dissatisfaction, and express a determination to provide such means of communication by a central department, it can be done.

There is no reason, however, so far as we can see, why the amalgamated interests should not serve the public faithfully, economically, and satisfactorily. The field open to them is enormous. Telephony is in its infancy, and its general adoption for business and domestic purposes is a mere question of time. We have a decided impression that hitherto the annual charge has been too high; but now that we have unity of action, no doubt this question will be carefully considered. Then the engineers of the companies must adopt a less dangerous system in lieu of the present overhead system of wires, or an accidental breakage of one standard may so influence public opinion that the Government will be compelled to act in a manner adverse to the interests of the companies.

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CORRESPONDENCE.

THE POSTMASTER-GENERAL AND THE TELEGRAPHISTS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The question of reading "Morse" as concerning commercial circuits is wholly one of degree. Any person who knows the combination of dots and dashes forming the Morse letters can, of course, either read or transmit words by that system, whether the combination of signs be communicated by Morse sounder or Morse recorder, or whether the blind converse by the sense of touch, or the deaf mute by merely *winking!* Apart, however, from the unsatisfactory nature of Morse sounders at any time for commercial circuits, the high skill and constant practice of the Post Office telegraphists cannot be replaced on any sudden emergency by selections from the Royal Engineers; and if the difficulty could be met by increasing the number of workers, the present accommodation would be inadequate. Probably not five per cent. of those who can read Morse's written signs are capable of transmitting them readily by the Post Office system, and it is admitted that facility in transmitting the signs is even less difficult to acquire than facility in reading the Morse sounder.—Yours, &c., RICHARD HERRING.

THE ELECTRIC LIGHT IN ARCHÆOLOGY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In the last number of the *Academy* it is stated that Professor Maspero has discovered the sepulchre of a very ancient Egyptian king, the walls of which are covered with Egyptian hieroglyphics. As such fragments of primæval history are very precious, it is to be hoped that they will be accurately copied before they are disfigured by the curiosity of tourists and mischief of the natives. This can best be done by photography.

Professor Piazzi Smith tried to photograph the interior of Cheop's Pyramid by means of the magnesian light, but he failed from the cloud of magnesian smoke which immediately darkened the air in those close chambers. No such objection exists to the use of electric light, and a comparatively small Siemens generator would, I think, suffice. It could be established at the entrance of the Pyramid, and connected with a Jablochkoff lamp in the sepulchre by wires of no great length, and might be driven by horse or man power. Perhaps one of your correspondents who is more familiar with this apparatus than I am might be induced to state what size generator would be sufficient to illuminate a wall at the distance, say, of twenty feet, powerfully enough to photograph the characters traced on it. It must be kept in mind that the electric light contains a far greater proportion of photographic rays than any other source of illumination. R.

THE ELECTRIC LIGHT IN INDIA.*

Full particulars have now reached us of the experiment lately made at the Howrah Railway Station by Mr. Louis Schwendler, Electrician of Government Telegraphs in India, with a view of testing the applicability of electric lighting at railway depôts in that country. One condition of its introduction was simplicity of construction and management, so that the ordinary natives, whose skill is not of a high order, might safely be left in charge of the system. Mr. Schwendler, under these circumstances, has preferred the method of using a few large lights rather than a great number of small ones. Indeed, he lays it down that each electric light shall have its separate dynamo-machine, and that the carbon holders, once carefully adjusted by experts, shall require no further attention. For the practical purposes in view he has also found that it is best for each light to be reflected upwards against the white ceiling, which diffuses the illumination over a wide area without causing any inconvenience to the eye. This method permits of naked arcs being used, and there is, therefore, no loss by reason of ground glass globes.

The goods shed where the initial experiment has been tried encloses an area of 48,000 square feet, being 480 feet long and 100 feet wide. Only four lights were employed, two on either side of the lines, and the illumination obtained was found to be amply sufficient to enable the trains to be loaded expeditiously, and far more conveniently than with the aid of gas. The reflectors are of zinc, lined with silvered glass, and are four feet across, their angles being formed so that the largest areas for direct and reflected rays are covered. A wire gauze screen intercepts any particles of burning carbon from falling on the goods below. Three Siemens' machines and two of Gramme's machines are kept on the spot, one of which is spare. The steam engine is a two-piston horizontal of 25 h.-p., working at its best when driven at the rate of fifty to sixty-five revolutions per minute, and is used ordinarily for pumping water into the station reservoir. It is the existence at Indian railway stations of engines for purposes of this latter kind that renders their application to electric lighting by night exceptionally economical. The system was introduced at the Howrah station last July, and has been at work ever since when the traffic required it. These four lights gave an average illumination equal to about 9,000 candles, with a consumption of 12·5 h.-p., or roughly 720 candles per h.-p. Careful calculations as to cost are furnished in the report, but, of course, the items of expenditure upon material and labour are, for the most part, peculiar to India. They show, however, that the adoption of electric lighting on railways in that country is perfectly practicable, and might be attended by considerable saving.

* Abstract of Report on the Electric Light at the Howrah (Calcutta) Railway Station, by Louis Schwendler, M.I.C.E., &c., &c., Electrician of Government Telegraphs in India.

PHYSICAL SOCIETY.—APRIL 9.

Professor W. G. ADAMS in the chair. Professor Helmholtz was elected an honorary member of the Society, and Dr. James Moser an ordinary member.

THERMAL ELECTROLYSIS.

Dr. J. H. GLADSTONE read a Note on Thermal Electrolysis, by himself and Mr. Alfred Tribe. The authors found that when sheet silver was plunged into fused silver chloride, or iodide of silver, crystals of silver formed on the sheet. Similarly, copper immersed in fused cuprous chloride, copper crystals deposited on it, and when zinc was placed in melted zinc chloride or iron in melted ferrous chloride these two metals cyrstallised on the plates. They found this to be due, not to a difference in the physical condition of the rolled metals, but to the unequal heating of the different parts of the immersed metals. By the contact theory of voltaism, there will be a difference of potential between the metal and the liquid chloride in contact with it, and this difference of potential will vary with temperature. Since all parts of the immersed metal cannot be supposed at the same temperature always, there is the possibility of a current being set up and consequent electrolysis of the salt. This view was corroborated by heating the fused salt unequally, when a crop of crystals appeared on a silver rod plunged in the cooler part of the liquid. Again, two silver rods connected together were plunged, the one in a hotter the other in a cooler part of the fused silver chloride, and at the end of fifteen minutes the latter was studded with crystals of silver, whilst the former was clean. A galvanometer showed a stronger current between the rods the greater the difference of temperature between the parts of the fluid in which they were placed; and transposing the rods reversed this current.

RADIATION THROUGH EBONITE.

Captain ABNEY exhibited a number of photographic negatives taken by himself and Colonel Festin by radiation through thin sheets of ebonite. The light from the positive pole of an electric lamp was sent through a thin sheet of ebonite $\frac{1}{64}$in. thick, and photographs taken showed the radiation to have a low wavelength, from 8,000 to 14,000. The carbon points of the lamp could be photographed through the sheet, and Colonel Festin observed the sun's disc through it. The ebonite showed a grained structure, and different samples of ebonite gave different results, but all gave some result, in course of time at least; old ebonite, like that used in some of Mr. Preece's experiments, scattering the light more than new ebonite. Dr. Moser exhibited the passage of the rays through the ebonite to the audience by means of a galvanometer. Professor Guthrie observed that Captain Abney had proved that light as well as heat traversed the ebonite, and Dr. Coffin stated that compositions of ebonite apparently the same might vary considerably.

LOCALISATION BY THE EYES.

Professor HELMHOLTZ addressed the meeting on the localisation of objects by the eyes. We estimate distance with one eye by the outlines of the more distant objects being covered by the nearer one where they meet, and by the shadows thrown by the anterior objects. These conditions are very rarely overpowered by others, as for instance binocular vision. This is shown by Dove's pseudoscope, and the fact that closing or blinding one eye makes little difference to the power of judging distance, especially when not very close to the eye. The relative shifting of objects as the eye is moved from side to side, or to and fro or up and down, which may be called the parallax of motion, is also a strong factor in estimating distance. The author concludes from a study of the stereoscope that the perception of the absolute convergence of our eyes is very indistinct, and that only differences of convergence related to apparently near or distant objects produce the stereoscopic effect.

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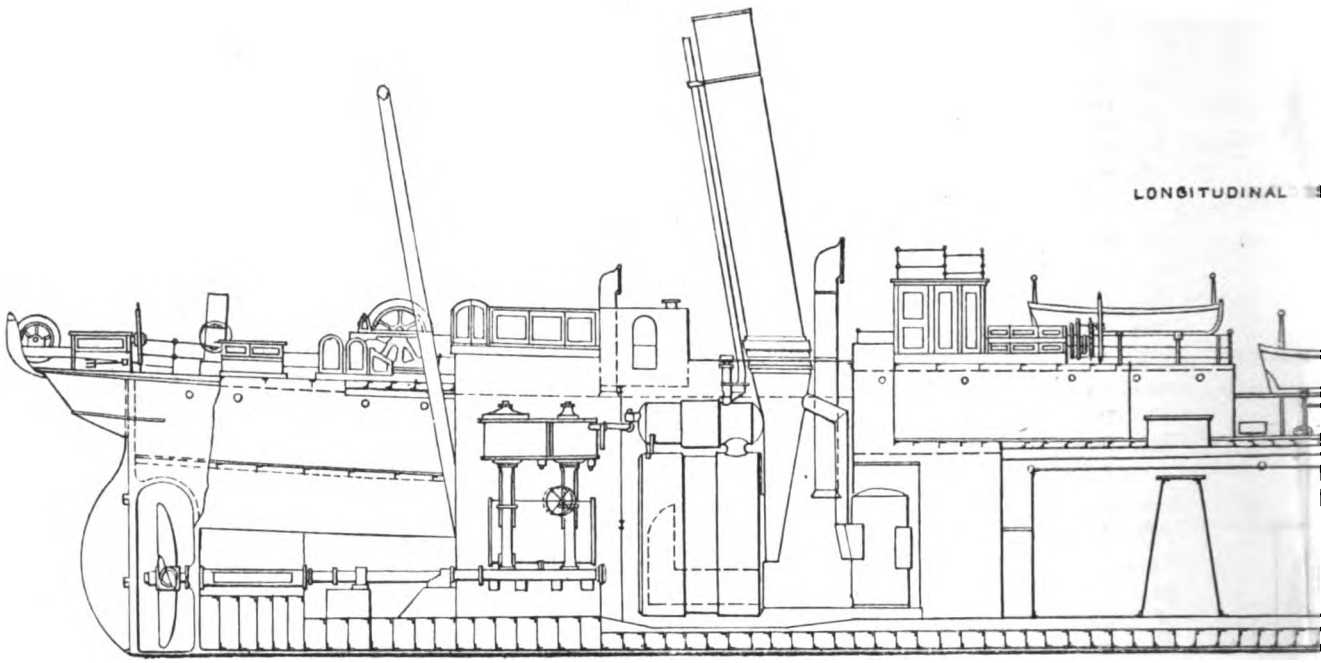
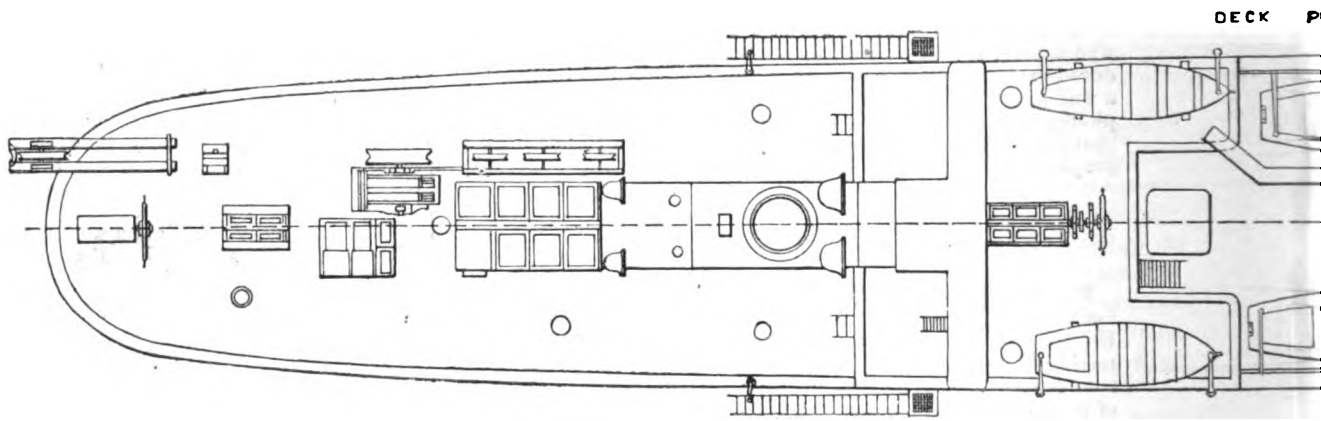
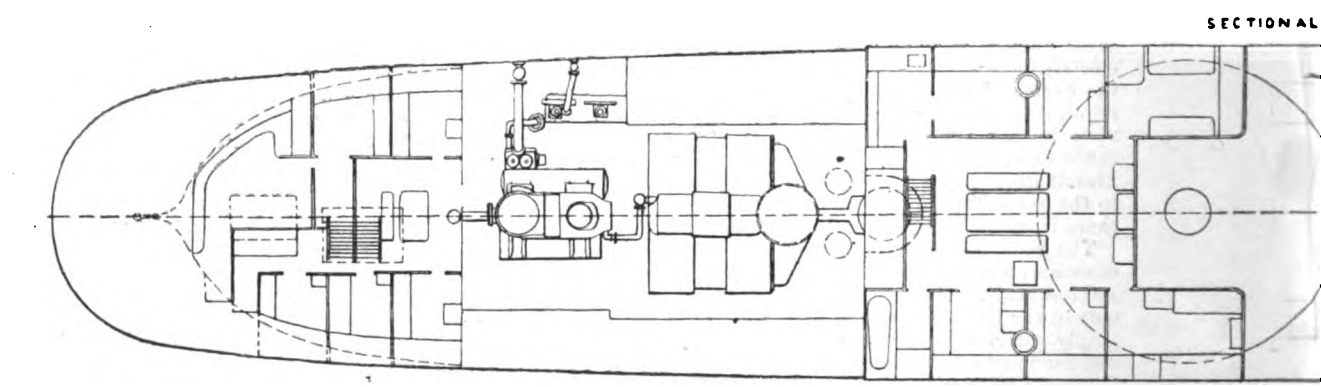
LAYING AND REPAIRING SUBMARINE TELI

(CONTINUED FR

We now come to the division of our subject dealing with the general arrangement of a telegraph steamer. The lecturer then described the best arrangement for a cable ship, illustrating this part of the lecture by means of a diagram of a longitudinal section of a cable ship designed by Mr. Jamieson. An illustration of this design has already appeared in a contemporary, and we have, therefore, thought it would be preferable to interpolate here the description of a cable ship recently built and actually at work (see diagram). The "Grappler" is a telegraph cable-repairing steamer constructed for the West India and Panama Telegraph Company, London, designed and built specially for their own use in the West Indies. The steamer is of the following registered dimensions:—"Length between perpendiculars, 208ft. 6in.; breadth,







moulded, 29ft.; depth of hold, 16ft. 2in.; gross tonnage, 867. The vessel has been built to the highest class at Lloyd's, and has an anchor deck forward, bridge deck amidships, and raised quarter deck aft. The crew are accommodated below the main deck forward; the captain, officers, and electricians amidships, and the engineers and firemen aft. The entire upper and lower decks, from forward of deck-house, are of iron sheathed with wood, the upper deck is of great strength, being stiffened by two longitudinal girders of plate and angle irons, and it

* A Lecture delivered at the Naval and Marine Engineering Exhibition, Glasgow, January 28, 1881.

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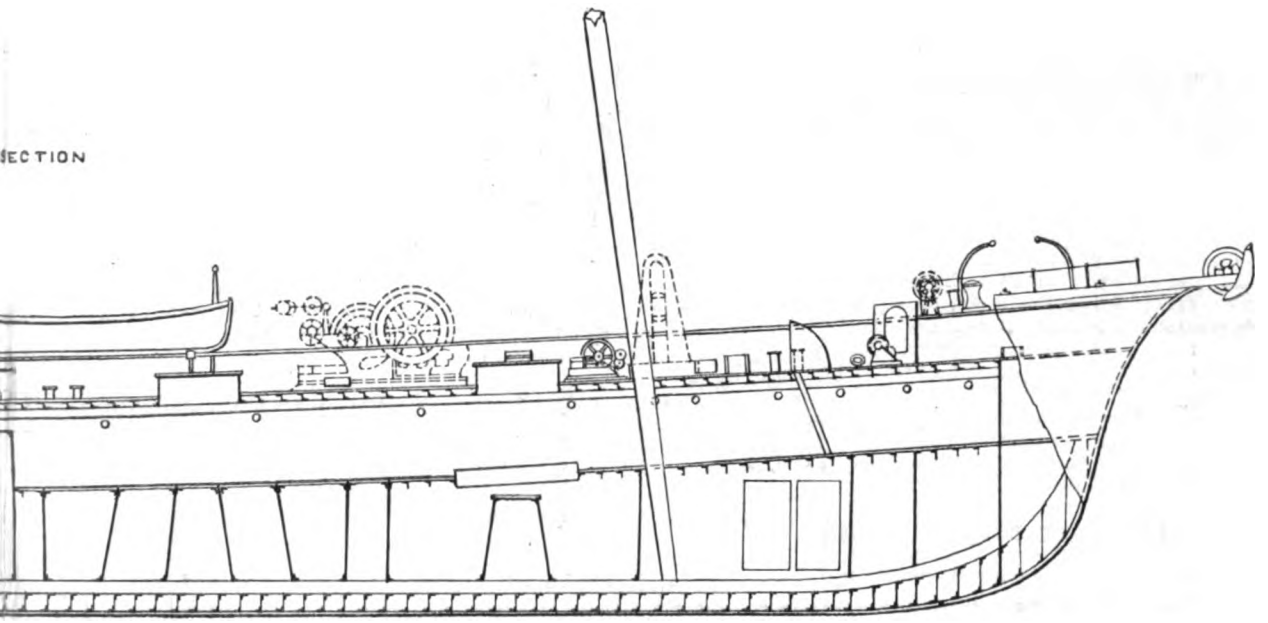
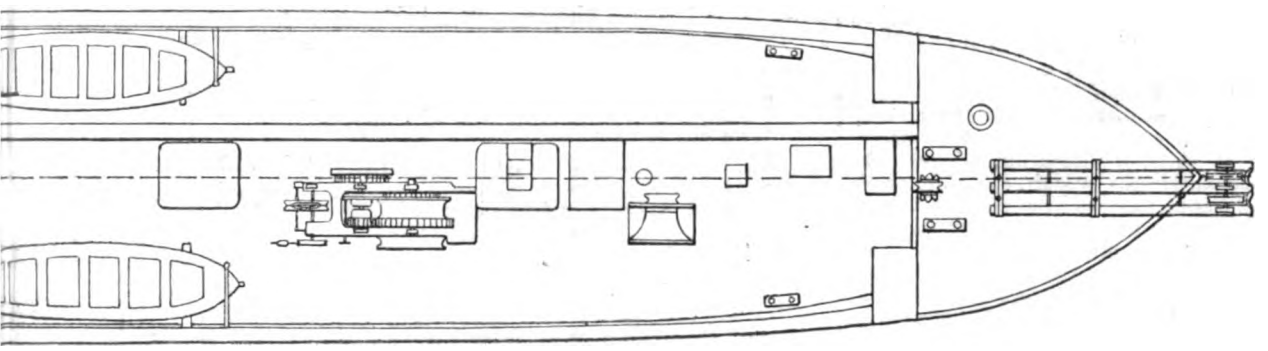
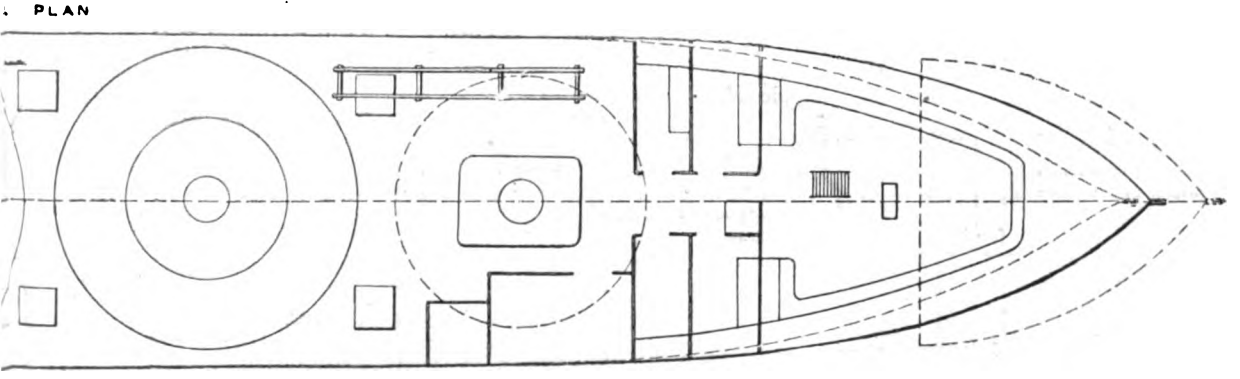
EGRAPH CABLES.* By A. Jamieson, C.E.

OM PAGE 259.)

s well fitted to carry the heavy cable gear. The cable tanks are three in number, and while of large capacity, are so arranged as to give the greatest possible space in the 'tween deck for coiling cables. No. 1 tank, placed furthest aft, is a single tank ; No. 2 tank is annular, and comes up to level of lower deck; and No. 3 tank is a single tank, plated to the underside of the lower deck. All the tanks are itted with watertight cones, and are well provided with facilities for filling and discharging water. There is a double bottom of considerable xtent which is fitted as a water ballast tank. The picking-up and paying-out cable machinery is very powerful and adapted for deep sea work ; here are two sheaves over the bows and one sheave aft. In addition to the ordinary cable gear there is a cable serving machine placed







n the 'tween decks forward, and a special engine for holding the cable at any point on the vessel. The outfit of boats is exceedingly large, and the steamer is particularly well found in regard to all that can fit her for the particular work she is to be employed in. The propelling machinery is placed well aft in the ship. The engines are compound surface condensing, with cylinders of 25in. and 50in. diameter, and a stroke of 36in., and capable of exerting 550 horse-power. The engines are fitted with a Durham marine governor, and all the most recent improvements. The boiler is of the circular multitubular type with four furnaces, and of sufficient power to supply steam, not only to the main engines, but to the special machinery on deck for working the cable gear. In a recess in the cross bunker there is a supplementary boiler on Cochran's pattern

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for supplying steam to the winch forward. Every attention has been given to procure the greatest possible light and ventilation throughout the entire vessel. The importance of this cannot be overrated where so many hands have to be employed, and where the climate is so bad as on the cost of Brazil. The vessel and machinery have been constructed respectively by Mr. James Laing, of Sunderland, and Messrs. R. and W. Hawthorn, of Newcastle-on-Tyne, from the designs and specifications of Messrs. R. McKaig and J. Carlton Stitt, of Liverpool, consulting engineers to the company, and under whose inspection the work was carried out." [We are indebted for our illustration and this description to the *Engineer*.—ED. *E.*].

A brief reference was then made to the paying-out and picking-up gear, which are, however, treated at length further on. The lecturer then continued. In the meantime let us suppose a ship properly equipped with such arrangement of tanks and machinery, fully found and manned, with efficient telegraph engineers, electricians, captain, and crew, ready to start on an expedition. Preparatory to laying the cable, however, a careful survey of the shores where the cable has to be landed, and particularly of the sea bottom between, must be taken. This is a point that was very much neglected in the early days of submarine telegraphy, and many a company now sadly repents this want of precaution, from the fact that their cables have broken and given out. You must understand clearly that the bottom of the sea has been found just as irregular as the land on which we live. There are as deep valleys and as high eminences below the ocean as there are above. I have myself measured a difference of depth of over 6,90ft. in a distance little more than a ship's length, and taken soundings two miles deep, while only a few miles distant there was shallow water. Take a look at this sketch on the black board, and you will at once have an idea of the configuration of the sea bottom in some places. Fortunately for cable companies it is not all irregular like this, and in the Mediterranean we took a line of soundings from Marseilles to Bona in Africa in the Eastern Telegraph Company's ss. "Chiltern," for the purpose of determining what was the nature and configuration of the bottom, and found a beautiful easy incline, or slope, or descent, ten miles from Marseilles, ranging from 1,000 to 1,745 fathoms, and then as gradual a rise on the other hand to Bona.

This we did by means of Sir William Thomson's large, excellent, and practical sounding machine, which I shall describe to you in a few minutes. Here you have before you his smaller machine, which he kindly lent me through Mr. White, of Sauchiehall-street, the well-known maker of his instruments.

This instrument is specially designed for taking soundings in shallow waters, up to 100 or 130 fathoms, without stopping the ship; in fact, going at full speed 16 knots an hour, and say to 300 fathoms. It is found to be of the greatest possible use to captains making port in foggy or dirty weather, and no ship should be without one, and more especially telegraph steamers, as they have to potter in all sorts of places near *shore*. The whole machine is placed in a watertight trough, containing lime water, to prevent the steel pianoforte wire from rusting. Then we have a small galvanised sheet iron or steel drum, revolving truly on its bearings, supported by lignum vitæ brackets. The drum is one yard in circumference, but the tell tale registers fathoms. It contains 300 fathoms of best pianoforte wire, ·03in. in diameter, weighing 1½lb. per 100 fathoms, and bearing a strain of 230lb. without breaking.

This wire is therefore very light, strong, and of small area, the chief requisites for a good sounding line. Attached to the end of the wire are three or four fathoms of cod line, and to the end of that a long sinker. A brass tube containing a small glass one hermetically sealed at one end is attached to the cod line about ten feet from the sinker.

It is well known that the pressure upon a body immersed in water is proportional to the depth to which it is sunk, so the air in the glass tube is compressed by "head of pressure," and the interior of the tube being coated with chromate of silver, which is soluble in salt water, the following action takes place, thus leaving a mark in the tube proportional to the depth to which it has been sunk.

A description of the new machine and rules for its use are given further on, to which I have only now to add a few words regarding the glass tube depth gauge. Erichsen's self-registering sounding lead (patented in 1836,) depending on the compression of air, might be used with the machine, but the simpler form before you is preferable as being surer. It, too, depends on the compression of air, but in it the extent to which the air has been compressed is marked directly on the interior of the straight glass tube by the chemical action of sea water on a preparation of chromate of silver with which the tube is lined internally. Between the salt of the sea water and the chromate of silver a double decomposition takes place, the chlorine leaves the sodium of the common salt and combines with the silver, while the chromic acid and oxygen leave the silver and combine with the sodium. Thus chloride of silver, white and insoluble, remains on the glass in place of the orange-coloured chromate of silver lining as far up as the water has been forced into the tube, and the chromate of sodium dissolved in the water is expelled as the air expands when the tube is brought to the surface.

$$2NaCl + Ag_2CrO_3 = 2AgCl + Na_2CrO_3.$$

(TO BE CONTINUED.)

THE SOCIETY OF TELEGRAPH ENGINEERS.

On Monday night, by invitation of the President and Council, the members of this society met at University College to welcome Professor Helmholtz. A large number of members responded to the invitation, thus expressing their opinion as to the high position taken by Professor Helmholtz in the ranks of science. Indeed, as an "all-round man," we doubt if there exists any more eminent. The quadrangle of the college was brilliantly lighted by one of Crompton's lamps, which we were informed was giving this excellent effect at a minimum expenditure of current, and hence of fuel. Another of these lamps was in use inside the building, and the library, in which the meeting took place, was partially lighted by a number of Mr. Swan's lamps. The whole current was supplied by a Gramme machine, worked by an engine showing an expenditure of energy equivalent to 12·5 horse-power (indicated).

A small but interesting collection of electrical apparatus was shown, among which we noticed AYRTON and PERRY's apparatus for measuring the efficiency of an electric motor, a machine which was described at the ordinary meeting of the society on Thursday. The same gentlemen also exhibited their dead-beat astatic galvanometer, with very high insulation, and an apparatus for measuring the E.M.F. of contact in different gases at different pressures, with automatic cleaning of the surfaces. Mr. SHELFORD BIDWELL showed his apparatus to illustrate the method of transmitting pictures of objects by telegraph. The anxiety shown to obtain some knowledge of this apparatus was very great, the recess being constantly crowded. Mr. LATIMER CLARK exhibited a collection of rare books on electrical subjects from his library. Among others were shown the works of

Porta, J. B. *Magiæ Naturalis*, &c. 1558.

[Contains at page 90 the earliest allusion to the imaginary sympathetic magnetic telegraph, formed by two similar mariners' compasses with letters round their margin, which was afterwards so frequently alluded to by the old writers, and among others by Strada, and translated by Addison in the *Spectator*. It is alluded to more fully in the later editions.]

Norman, Robert. *The Newe Attractive*. First edition. 1581.

[The earliest English work on magnetism, very scarce and much esteemed. It describes the declination of the magnetic needle.]

Wright, E. *Errors in Navigation*. 1599.

[A scarce and early work, containing description of the mariner's compass and its use.]

De Sunde, J. H. *Steganologia and Steganographia*. 1600.

[One of the early writers on the imaginary magnetic telegraph and the most curious. He describes in cabalistic fashion the preparation of the two compasses, the needles of which must be made from the same piece of steel and magnetised by the same magnet. Attention is called by the ringing of bells placed upon the dials and rung by bar magnets. The needles are also actuated by bar magnets, and the letters are formed by one, two, three, or four movements as in the modern single needle telegraph. His real name was Daniel Schwenter.]

Stradæ, F. *Prolusiones*. 1617.

[Contains the poem on the Imaginary Lovers' Telegraph, afterwards translated and published in the *Spectator*, Dec. 1711.]

Glanvil, J. *Scepsis Scientifica*. 1665.

[Contains, at p. 149, a very interesting allusion to the imaginary magnetic telegraph.]

Scots Magazine for Feb. 1753. 1753.

[Contains, at p. 73, a letter by C. M. (*i.e.* Charles Marshall), in which a real electric telegraph is for the first time invented and described.]

Marat. *Recherches physiques sur l'électricité*. 1782.

[The author is the same who figured so prominently in the early days of the first French Revolution, and who was assassinated by Charlotte Corday.]

Green, G. *Mathematical analysis to the theories of electricity and magnetism*.. 1828.

[Contains, at p. 9, the earliest introduction of the word "potential," as applied to electricity. Extremely rare.]

Mr. LATIMER CLARK also showed a very interesting autograph

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letter of Sir Isaac Newton, which we believe has not hitherto been published. The following is a copy of the letter:—

(Copy.)

London, Dec. 15, 1716.

DEAR DOCTOR: He that in ye mine of knowledge deepest diggeth, hath, like every other miner ye least breathing time, and must sometimes at least come to terr: alt: for air.

In one of these respiratory intervals I now sit doune to write to you, my Friend.

You ask me how, with so much study, I manage to retene my health. Ah, my dear doctor, you have a better opinion of your lazy friend than he hath of himself. Morpheus is my best companion; without 8 or 9 hours of him yr correspondent is not worth one scavenger's peruke. My practizes did at ye first hurt my stomach, but now I eat heartily enow as y' will see when I come down beside you.

I have been much amused by ye singular *φενομενα* resulting from bringing of a needle into contact with a piece of amber or resin fricated on silke clothe. Ye flame putteth me in mind of sheet lightning on a small (how very small) scale. But I shall in my epistles abjure Philosophy whereof when I come down to Sakly I'll give you enow. I began to scrawl at 5 mins frm 9 of ye clk, and have in wrting consmd 10 mins. My Ld. Somerset is announced.

Farewell, Gd bless you and help yr sincere Friend

(Signed)

ISAAC NEWTON.

To Dr. Law, Suffolk.

Mr. A. J. FROST. librarian of the society, exhibited several rare and curious books. Among others we may mention:—

Aurifaber, A. *Succini historia, &c.* 1551.

[Contains references to the electrical properties of amber. Specimen of early binding. Scarce.]

Peregrinus, Petrus. *De Magnete, &c.* 1558.

[The earliest known book on Magnetism. Very scarce.]

Taisnier, J. *De Natura Magnetis.* 1562.

[A piracy of Petrus Peregrinus. Rare.]

Digges, Thomas. *A prognostication of right good effect.* 1592.

[Meteorological. Very curious.]

Gilbert, Dr. *De Magnete.* 1600.

[One of the earliest and most important books on magnetism. Three editions, 1600, 1628, 1633.]

Ronald's, Sir F. *Correspondence, &c., relating to the Electric Telegraph. MSS.* 1816-1873.

[This interesting collection contains the letter from Sir J. Barrow, the Secretary of the Admiralty, saying that "Telegraphs of any kind are now wholly unnecessary," together with Ronald's letters to the Government, &c.]

Ronald's, Sir F. *Description of an Electrical Telegraph.* 1823.

[One of the most interesting books connected with the history of telegraphy. The first English book on the electric telegraph.]

Messrs. CLARK, MUIRHEAD, and Co. exhibited specimens of their manufacture of Livesing's Fire Damp Indicator, a ¼ ohm rheostat for duplex work on submarine cables, various testing instruments, Winter's Railway Block Instruments, &c.; whilst Messrs. ELLIOTT BROTHERS exhibited the large dynamometer, the details of which we illustrate in another page, and a selection of testing instruments. Mr. W. H. PREECE showed his apparatus and experiments illustrating the conversion of radiant energy into sound, and also showed that various pieces of ebonite differed immensely in the property of diathermancy, some pieces allowing heat to pass without difficulty, others being totally impermeable. Mr. SPAGNOLETTI a model of his new fire alarm. Several improvements have recently been added to it, and now it indicates automatically, by means of a pointer and a scale, the position of the place whence the alarm was given. Messrs. SIEMENS, SABINE, STROH, and others have contributed to the collection, Mr. Stroh showing the mechanical vowel sounder—an instrument quite appropriate to the occasion, since some of Professor Helmholtz's best-known researches have been in this direction.

THE FUTURE DEVELOPMENT OF ELECTRICAL APPLIANCES.*

BY PROFESSOR JOHN PERRY, B.E., ASSOC. M.I.C.E.

(CONTINUED FROM PAGE 252.)

I must now try to give you an idea as to how these measurements are made. The very elegant dynamometer employed by our chairman to measure the power which is being transmitted to a machine I am not at liberty to describe. The plan devised by Professor Ayrton and myself is capable of being applied at very small cost to existing shafting in factories, so that the power given to any shaft may be known. A is a shaft which is to receive power. B is a loose pulley driven by a belt. C D is a wheel whose rim is fixed to the rim of B; its crooked arms are made of flexible steel, its boss being keyed to the shaft. Evidently B can no longer be called a loose pulley; if it turns, it must cause the shaft to turn, but the turning moment is accurately represented by a certain amount of yielding of the steel arms of C D. If this yielding is known, and also the speed, the horse-power transmitted is also known; for, so far, we copy the principle of General Morin; but, instead of using his elaborate system of measurement, we simply convert the tangential strain into a radial motion which is visible. This may be done in various ways, of which the following is the most simple:—A stiff arm, E F, is fixed to the shaft at F; at E and at a point C of the wheel, the ends of two light links are pivoted, which are hinged together at G, where there is a bright bead. Evidently, if the distance C E becomes large, because much power is being transmitted, the bead G moves out from the centre, and, therefore, the circle of light described by it has a greater radius. We really employ two sets of hinged rods like E G and G C for very different amounts of power transmitted by the arrangement. Our method of measuring the radius of the circle described by the bright bead G depends on the use of a little telescope, in the present instance moving on a graduated arm; but many other methods have presented themselves. Other dynamometers, which have till now been in use by Mr. Ayrton and his students, are shown in the diagrams. For measuring very strong currents, such as are used in electric lighting, Professor Ayrton and myself have devised this "dead-beat" galvanometer. Without going into a detailed description of the instrument, I may mention that it possesses the following great advantages:—Not only can the strength of any current be read off at once in webers, but the user can at any moment test his own instrument, or graduate it, as it is technically called, by employing only the weak current produced by a single Daniell cell. This result is arrived at by the device of causing the weak current to circulate 60 times round the magnet, while the strong current only goes round six times; a special form of commutating arrangement enabling the very same wires in the galvanometer to serve for both strong and weak currents; hence, comparisons can be made, not merely approximately, but with absolute accuracy, even if the wires are wound on the galvanometer quite carelessly.

The instrument shown in the other diagram may be graduated in the same manner, as it is also provided with the peculiar kind of commutator which we have designed. We call it an arc horse-power measurer, because its deflections are proportional to the product of difference of potential established in an electric light, into current flowing through the arc, or incandescent carbon, and hence these deflections (see wall-sheet II.) show at a glance the horse-power given out at that place. The electro-dynamometers of Dr. Siemens and of Mr. Andrews are here before you, and may be used during the lecture to measure currents. Mr. Andrews simply uses a steel-yard to balance the attraction between two coils when the current flows in them, when they are at a fixed distance asunder, and he, therefore, like Dr. Siemens, measures the mean square of the current flowing. These instruments have the disadvantage that an ordinary pair of scales has in comparison with a spring balance—viz., that a sudden temporary change in the thing weighed cannot be measured; but they have the advantage of great accuracy in the measurement of a constant effect.

To measure the light itself in standard candles, Professor Ayrton employs our photometer, of which two specimens are before you, and there is an enlarged drawing on the wall. The principle of old methods of measurement of strong lights was to weaken the intensity of illumination of a screen by taking the screen far enough away. Only in this way could the illumination of the screen by the electric light be made equal to the illumination of a similar screen by a standard candle. Our plan of weakening the light from an electric lamp is not by going forty or eighty feet away from it—for people who deal with electric lamps do not often possess a large enough chamber with blackened walls—but by letting, instead, the light pass through a concave lens. The principle is then exceedingly simple. Mr. Wormell has been making a few measurements whilst I have been talking, and I see that this electric light has varied from 2,214 to 2,136 candles in the last three minutes. Sir W. Thomson suggested to us to make two measurements, one through green and the other through red glass, for reasons which must be obvious. Anyone who may wish it will have an opportunity of measuring the power of an electric light for himself after the lecture.

* Paper read before the Applied Chemistry and Physics Section of the Society of Arts on March 24th, 1881.

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From all this you will see that perfect methods exist for measuring the power which is being given out as heat or light in any part of a circuit, as well as the power given to the electrical machine. In fact, we have a perfect measure of what is called the efficiency of our arrangement. It is hardly necessary to tell you that every house and every street may be lighted electrically. Into the proof that, in the future, arc lamps of thousands of candle-power at elevations proportional to the square roots of their powers will be used for large spaces, and that incandescent lamps of only hundreds of candle-power are suitable only for private houses—into a consideration of these statements I shall not enter, because Professor Adams is dealing with the question in his Cantor Lectures. You all, in one way or another, feel that electric lighting is a foregone conclusion. But, perhaps, you were not aware that buildings may be heated by electricity. The neighbours of this iron wire will say that it gives out a considerable quantity of heat, but whether the heating may be performed economically will depend on the story told us by the measurements which have been made. Now let me turn my tap again. I let my current pass through this insignificant little dynamo machine, and you observe that it is in motion; not only is it in motion itself, but it is driving this lathe. A machine is receiving mechanical energy outside, it converts this into electrical energy, which is conveyed by wires into the room and to the machine before you, where it is converted into mechanical energy again. I think I shall never forget the astonishment of a workman in Sheffield, who had put up a saw-bench for use at Professor Ayrton's lecture, and who was about to rehearse his part. He looked at the motionless saw, he had his hand on the wood, he saw there was a belt from a little mite of an electric machine, two wires dangled from the ceiling to the machine, and this was all. What notions of being played with came into his mind I do not know, but when, at the distant place, a water-engine was started to drive the distant machine, when the saw set off nearly at its full speed, and the two dangling wires were evidently the only methods of communication, this thoughtful workman's face expressed in full perfection the absence of all his reasoning powers. I do not wish you to lose your reasoning powers, but it is necessary that you should get thoroughly impressed with the notion that the power to drive this lathe is actually being transmitted through these limp and motionless wires.

I should like to be able to hold that machine motionless, and to prove to you that the current flowing through the wires is immediately diminished when the machine begins to move; in fact, I want to show you that this machine produces an electromotive force which is in opposition to that of the distant machine. You see that we are just able to hold it, and now I am informed that the current flowing is 19·5 webers, whereas, if we let it run, and drive the lathe and the sewing machine and this fan, you will find that the current is diminished. It is 11·2 webers, or about half what it was before. It is not necessary to give you further examples of this transmission of power by electricity, but on account of the evident importance of the matter to the health of the community I will give you one more, and I turn the tap, and you all see that this insignificent little machine is driving a ventilator. This ventilator might be used in a chimney in the summer time, when fires are not in use, or any suitable outlet from rooms; and pray remember that mechanical ventilation is ever so much more efficient than what is called natural ventilation, in which advantage is taken of the lightness of warm gases.

Now, what do these examples show you? They show that if I have a steam-engine in my back yard I can transmit power to various machines in my house, and if you measured the power given to these machines you would find it to be less than half of what the engine driving the outside electrical machine gives to it. Further, when we wanted to think of the heating of buildings and the boiling of water, it was all very well to speak of the conversion of electrical energy into heat, but now we find that not only do the two electrical machines get heated and give out heat, but heat is given out by our connecting wires. We have then to consider our most important question. Electrical energy can be transmitted to a distance, and even to many thousands of miles, but can it be transformed at the distant place into mechanical or any other required form of energy, nearly equal in amount to what was supplied. Unfortunately, I must say that hitherto the practical answer made to us by existing machines is, "No;" there is always a great waste due to the heat spoken of above. But, fortunately, we have faith in the measurements, of which I have already spoken, in the facts given us by Joule's experiments and formulated in ways we can understand. And these facts tell us that in electric machines of the future, and in their connecting wires, there will be little heating, and therefore little loss. We shall, I believe, at no distant date have great central stations, possibly situated at the bottom of coal-pits, where enormous steam-engines will drive enormous electric machines. We shall have wires laid along every street, lapped into every house, as gas-pipes are at present; we shall have the quantity of electricity used in each house registered, as gas is at present, and it will be passed through little electric machines to drive machinery, to produce ventilation, to replace stoves and fires, to work apple-parers, and mangles, and barbers' brushes, among other things, as well as to give everybody an electric light.

Probably you think it very strange that I should show you the inefficiency of electric transmission of energy, and then make this bold assertion. Well, the fact is, that the ordinary electrical machines in use have not been constructed with a view to economy. They have been constructed to show that brilliant lights and considerable power may be produced from small machines. They have, at a comparatively small cost, attracted attention to the fact that electricity is an important agency. In so far they have done well; but on the other hand they gave rise to the well-known assumption that 50 per cent. of the mechanical power given to the generator was the maximum amount which could be taken from the motor. The true solution of the problem of transmission of power was, I believe, first given by Professor Ayrton in his Sheffield British Association lecture. It had been supposed that to transmit the power of Niagara Falls to New York, a copper cable of enormous thickness would be needed. Mr. Ayrton showed that the whole power might be transmitted by a fine copper wire, if it could only be sufficiently well insulated. He also showed that, instead of a limiting efficiency of 50 per cent., the one thing preventing our receiving the whole of our power, was the mechanical friction which occurs in the machines. He showed, in fact, how to get rid of electrical friction. I will briefly give you our reasons. A machine at Niagara receives mechanical power, and generates electricity. Call this the generator, and remember that wall-sheet III. teaches us that the mechanical power is proportional to the electromotive force produced in the generator, multiplied into the current which is actually allowed to flow. Let there be wires to another electric machine in New York, which will receive electricity, and give out mechanical work, as this machine does here. Now, I showed you a little while ago, that this machine, which may be called the motor, produces a back electromotive force, and the mechanical power given out is proportional to the back electromotive force, multiplied into the current. The current, which is, of course, the same at Niagara as at New York, is proportional to the difference of the two electromotive forces, and the heat wasted is proportional to the square of the current.

Let electric motive force of generator be E; of motor F. Let total resistance of circuit be R. Then if we call P the horse-power received by the generator at Niagara, Q the horse-power given out by motor at New York, that is, utilised, H the horse-power wasted as heat in machines and circuit, C the current flowing in the circuit.

$$C = \frac{E - F}{R},$$

$$P = \frac{E\,(E - F)}{746\,R},$$

$$Q = \frac{F\,(E - F)}{746\,R},$$

$$H = \frac{(E - F)^2}{746\,R},$$

$$Q : H :: F : E - F.$$

To put it more shortly still, the power wasted is proportional to the square of the current flowing, whereas the power utilised is proportional to the current, and also to the electromotive force of the motor. The greater, then, we make the electromotive forces, the less is the loss of power in the whole operation. Perhaps you will see this better from the water analogy. A small quantity of water flowing through a water-main may convey a large amount of energy if it only has sufficient head. The frictional loss of power is independent of the head, but depends very much on the quantity of water. In the model before you is the water analogy. A is a reservoir, kept filled with water by a steam pump, which draws the water from the sea level K K. Water flows from reservoir A to distant reservoir B, where it drives a turbine giving out work due to its head, B K. The current from A to B, through the communicating pipe, is the same always, so long as A and B are at the same difference of level, and therefore the frictional loss of energy is always the same, whereas the work utilised from B, by driving the turbine, increases proportionally to the height of B above the sea level.

(TO BE CONTINUED.)

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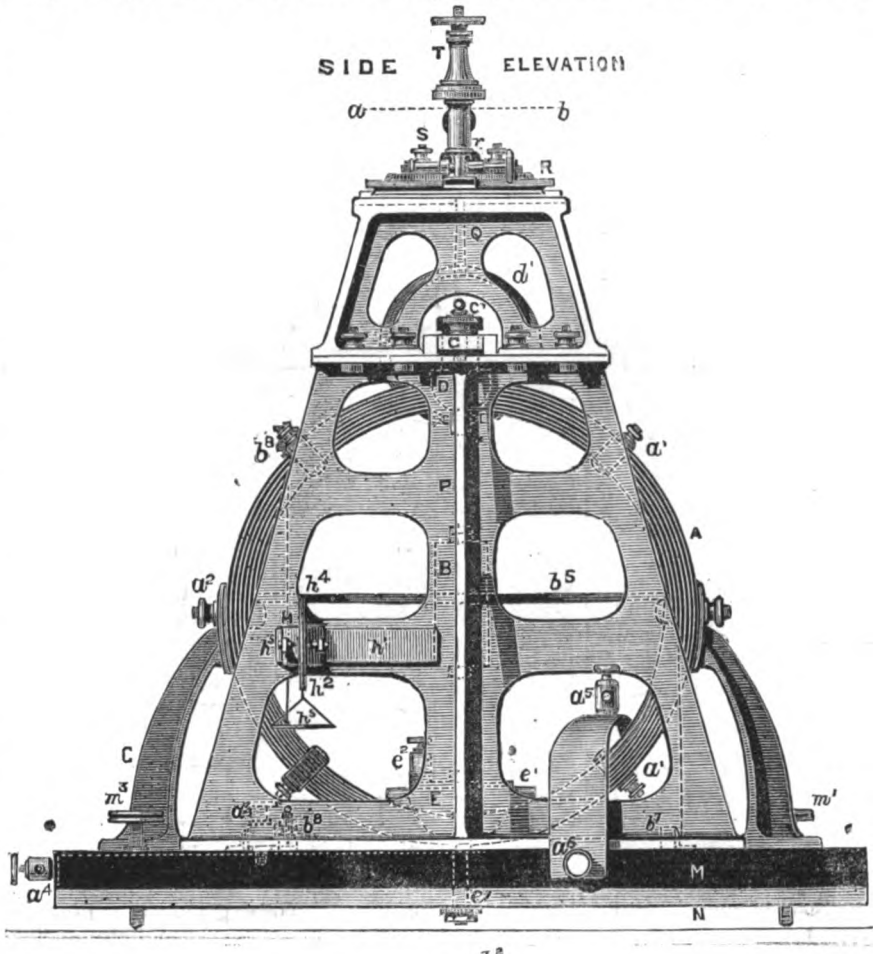
MEASURING ELECTRIC CURRENTS OF GREAT STRENGTH.

According to our promise, *vide* p. 246, we now illustrate in detail the instrument then described. The instrument was shown at the *conversazione* of the Society of Telegraph Engineers, held in honour of Professor Helmholtz at University College last Monday, and excited a considerable amount of interest. We trust that we may soon have to record the construction of a similar instrument for use in England.

In these detailed drawings A shows the large coil, which consists of six turns of a copper band. The turns are separated by ebonite rings, and fastened together by brass rods and insulated screw-nuts. The diameter of the coil is 12 inches from centre to centre. Each turn of the coil is 1·5 inch wide and ·083 inch thick. It can easily be understood that great difficulty was experienced in the construction of the instrument in obtaining each turn in its exact position. The coils are fastened to the plate by an insulated screw bolt.

The small coil shown angles to the large at B is at right coil, and, like it, consists of six turns of a copper band. The diameter of this coil, from centre to centre, is 2·5 inches. The width and thickness of each turn is the same as in the large coil. Just above the coil is a brass ring, b^1, which keeps the coil in its right position. A brass stud, b^2, carries a lever, also of brass, b^5, which is notched at intervals of one inch. These details will be easily seen from the illustration of the longitudinal section through centre. The stud b^2 is upon a piece of ebonite, which serves not only to carry the stem, but to insulate the coils and form a holder for the rods b^3 and e^6. At the ends of the lever b^5 are thin brass or steel needles, whose movements are read off on an ivory scale, b^7. The needle is prevented from making too great oscillations by the rod b^8. The cross piece C is of brass, insulated at both ends, carrying a plunger, as shown, which dips into the upper mercury cup D. To prevent heating, provision is made for a constant flow of cold water, the rubber pipes for the carrying of which are connected at e^6 and the opposite channel. A steel spring, d^1, is suspended as shown. The lower mercury cup E is surrounded by a channel for water, entering and leaving by the openings e^1. The base plate M is of ebonite, 1in. thick, fixed to the brass plate N ·5inch thick. G G are brass brackets, well insulated from the coil. H H are brass pulleys, sliding along the lever b^5, with grooves for the silk threads carrying the scale pans h^5. The framing P P is of brass, as is the bridge Q, and the bed plate R, which carries two mobile pulleys. The position of these pulleys is altered by sliding the brass brackets in the ebonite plate; $s's'$ show the guide pulleys, and s^3s^3 the brackets. The top piece T carries pulley t^1 for the silk thread fixed to ring a^1, and the height of the pulley is regulated by the screw above it. Three levelling screws of the usual kind are used for levelling the instrument.



The water enters first at one of the upper openings, cools the hollow chamber, passes out at the opposite opening, is carried down by a tube to one of the lower openings, whence it passes round the lower mercury cup and leaves by the other opening.

The current passes from the machine to the binding screws to which the wire is attached, thence through the lower mercury cup E, from E through rod to the outside ring of the small coil, passing through this coil to the brass stem, making contact with the interior turn of the coil, and then through the rod d^3 to the upper mercury cup D, and from here to the large coils.

The wrought iron parts are thickly plated with nickel, as are the pieces T, R, S, the framings P and Q, and the cross bar C.

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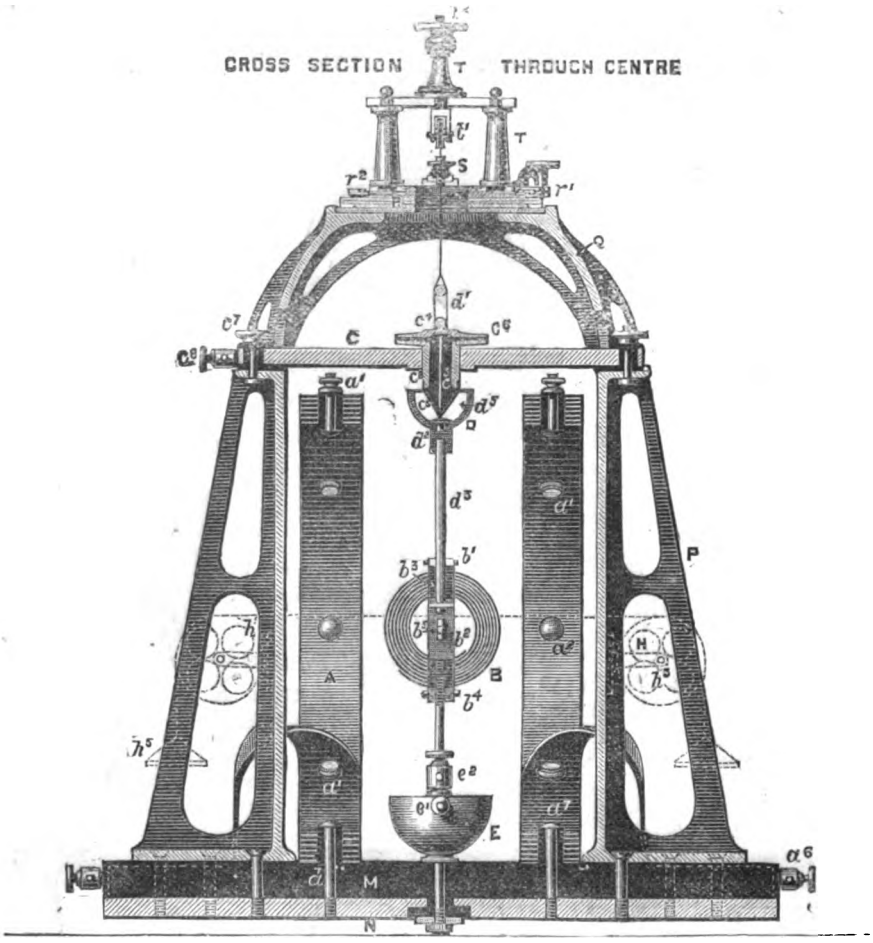
Mr. Hill in his paper says:—When deflection has occurred, weights are added to the pan on the side opposite, until the pointer-rod returns to the starting point. If the weight added is too great, the pointer-rod is drawn against the other wire stop. Weights may then be removed or put into the opposite pan until the right point is attained.

The weight employed exactly balances the magnetic force. The old mode of observing the zero point was not quite satisfactory. It was originally intended to use a vertical wire stop, the pointer-rod to be drawn back until it just touched the wire, but it was found that it was difficult to hit this point exactly. Finally, a scale was marked on the cylinder in front of the instrument, and a pointer of aluminium or other wire fastened to the rod, so that it would traverse the scale. This plan worked well, but a better method was suggested by Captain F. M. Ramsey, U.S.N., which is to use a light vertical pointer hanging over the scale on the base. When adjusted, the pointer-rod of the suspended coil should just touch the vertical pointer when the latter is at zero. The exact return to the same point would be easily seen, as a small excess of weight would cause a movement of the pointer over the scale.

The pans are of the same weight, and the threads by which they are hung are fibres of unspun silk. The friction of the pulleys is very small, and would be trifling if they were made with jewelled bearings. Also, one balances, or nearly balances the other, so that practically their friction may be neglected, although allowance might be made for it if extreme nicety were aimed at. It must be remembered that the actual observation is made when the coil is in the zero position, the weight taken being that required to balance the deflecting force. The movement of the pulleys is then very slight, and the weight acts exactly at right angles to the pointer rod.



For the measurement of the large currents derived from dynamo-electric machines minuteness is not demanded, since the variations due to fluctations in the currents, alterations in resistance, &c., are much greater than the limits of observation in such an instrument as this. Thus, in practice, when attempting to ascertain the current obtained per horse-power expended, we have to note the velocity of the machine, and the indications of the power dynamometer, together with the current's measure, as nearly as possible at the same moment. Quickness and simplicity of working, together with strength and compactness, are required in the electro dynamometer, and this instrument possesses these practical advantages, while it is capable of a good degree of accuracy.

The writer has employed it at the United States Torpedo Stations for measuring currents of from twenty to eighty webers. It is a good working instrument, and gives uniform results. It was made for experimental trial, and is defective in certain respects. With some improvements in construction, it would be a little more sensitive, particularly to comparatively small currents. The suspension arrangement is supported on the large coils, and lacks steadiness. It should be placed upon a distinct standard. A support for the deflecting coil when not in use should be added, and an arrangement for centering it quickly.

Messrs. Elliott Brothers have given us every assistance in obtaining the information and the drawings which we have been able to lay before our readers.

THE LONDON GAS-LIGHT COMPANY.—The directors of this company announced at its half-yearly meeting, on Wednesday last, the 13th instant, a reduction of 3d. per 1,000 cubic feet in their charge for gas thus bringing the price down to 3s. per 1,000.

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ABSTRACTS OF SPECIFICATIONS.

3496. IMPROVEMENTS IN APPARATUS FOR OBTAINING ELECTRICITY, *C. W. Harrison.—Dated 28th August*, 1880.—(*Not proceeded with.*) 2*d.*

The inventor employs a series of coils of conducting material, and in combination therewith an interior central bar or series of bars, the motion of which, within the coils and in the direction of their length, causes currents within them.

3509. IMPROVEMENTS IN ELECTRIC LAMPS, *John Hopkinson.—Dated 30th August*, 1880. (*Not proceeded with.*) *Price* 2*d.*

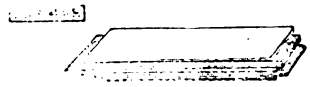
This invention has reference to the mode of regulating the distance between the carbons used for the production of the electric arc. Either or each carbon is carried from the piston of a hydraulic cylinder. Each cylinder is either so arranged that when fluid is allowed to flow out from that cylinder the carbon it carries advances, or so that when fluid is allowed to flow into the cylinder the carbon advances, or that when fluid passes from one cylinder to the other both carbons are caused to advance. The passage of fluid into a cylinder from a cylinder, or from one cylinder to the other, is controlled by a valve, which is opened or closed by an electro-magnet. This electro-magnet may be either in the principal electric circuit or in a shunt circuit of high resistance. A hand tap is also provided for permitting a rapid flow of fluid from or into a cylinder, or from one cylinder to the other. When a hydraulic cylinder is used for each carbon the inventor provides a third cylinder with a plunger, whereby the aggregate quantity of fluid in the two before-mentioned cylinders may be increased or diminished, and the position of the electric arc adjusted. In starting the lamp he makes use of a second electro-magnet. Generally, this is arranged in the principal electric circuit, and separates the carbons so soon as the current passes: but sometimes it is in a shunt circuit of high resistance, and acts to bring the carbons in contact for an instant at starting, and so starts the light. The current may be conveyed to the carbon or the pistons which carry them by a sliding contact. When very long carbons are used this may be arranged to serve the purpose of steadying the terminals of the carbons and keeping them in their correct position. In some cases the electro-magnetic valve is arranged as a float, which on rising causes a conical plug to enter a small hole. The lower part of the float may be of iron, forming an armature for the electro-magnet, which by pulling down the float opens the aperture. This electro-magnet may be adjusted in various ways, as, for example, by thrusting in or pulling out its iron core.

3670.—AN IMPROVED PROCESS OF REGENERATING THE FLUIDS OF GALVANIC BATTERIES IN WHICH CAUSTIC ALKALIS ARE EMPLOYED, AND OF RECOVERING THE ZINC HYDRATE FROM SOLUTION. *By A. M. Clark. — Dated 9th September*, 1880. *Price* 4*d.—(A communication from Emile Reynier, of Paris).*

This invention consists in a process of regenerating the electrolytic fluids of galvanic batteries in which caustic soda or potash is employed, and of recovering the zinc hydrate which has become dissolved therein by utilising the property of this oxide, of being abundantly soluble in a concentrated caustic soda or potash lye, only slightly soluble in a weak lye, and insoluble in plain water. The process of treating the electrolyte of a battery in which caustic soda or potash is employed, and which has become charged with zinc hydrate by the working of the battery, consists essentially in precipitating the oxide of zinc by the addition of water, reconcentrating and decarbonating the liquid. The proceeding is as follows:—Separate by decantation the insoluble carbonate of zinc which may have been formed by the carbonic acid of the air, or by any carbonates that may accidentally be present with the caustic alkalies; to the liquid freed from the insoluble carbonate of zinc add four to eight volumes of water, which precipitates the zinc hydrate, this precipitation being more complete the more the solution is diluted; decant, collect the zinc hydrate, wash thoroughly, and drain and dry it; then evaporate the dilute lye which has been drawn off, concentrating it till it attains its original density; finally, eliminate any carbonic acid the liquid may still contain by caustification with lime.

238,448. DUPLEX TELEGRAPH, *Gerritt Smith, Astoria, N.Y.—Filed December 14th*, 1880.

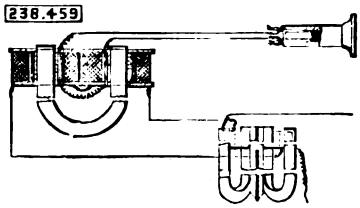
Brief.—A device for killing the static discharge. One pole of a condenser is attached to the main line and the other to a supplementary artificial



line, which passes to ground through the coils of the home relay, thus permitting the re-acting discharge of the condenser to neutralise that of the main line.

238,459. TELEPHONE RELAY, *Cornelius T. Tomkins, Red Bank, N.J., assignor to Eaton Telephone Company, Brooklyn, N.Y.—Filed November 29th*, 1880.

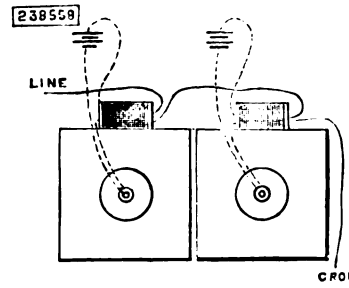
Claim.—The means, substantially herein described, of re-enforcing and continuing the transmission of telephonic sounds or articulations through long distance or great resistance, consisting of one or more permanent magnets, having upon its or their pole or poles a double induction coil, interposed at given points between the trans-



mitting and receiving instruments, and having a closed metallic local circuit between the helix on the magnet of the telephone and the primary helix on the re-enforcing magnet, the terminal ends of the secondary coil being the line and earth circuit, substantially as described.

238,558. TELEPHONE, *Francis Blake, Weston, Mass.—Filed January 15th*, 1881.

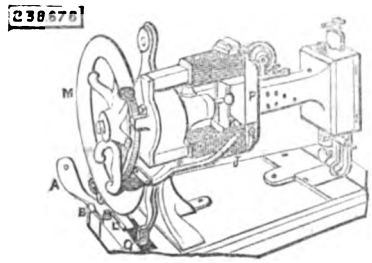
Claim. — The combination of two or more battery transmitters so placed as to be acted upon simultaneously by the same sounds, and each being in an independent local circuit, a part of



which forms the primary of an induction coil, while the several secondaries are in line in the main line.

238,678. ELECTRO-MAGNETIC SEWING MACHINE MOTOR, *George F. Green, Kalamazoo, Mich. —Filed January 30th*, 1879.

Claim.—(1) A sewing machine head or frame provided with a toothed wheel, O, combined with a revolving armature electric motor permanently attached to said head or frame, and a pinion, N^1, on the shaft of said armature in mesh with said toothed wheel, substantially as set forth. (2) The pin F, in combination with guide G, the pin F working or passing on either side of guide G, in the manner and for the purposes described. (3) The combination of levers A and B with spring and pad L, all operated in the manner and for the purposes described. (4) The lever B, provided with the laterally projecting pin F, combined with the lever G, provided with a lateral offset and a notch, whereby the motion of said lever B in one direction will cause said pin to engage said lever G to push it into action, and by engaging



with said notch hold it in action, and by a continued motion of B said pin will be passed over, and disengaged from said lever G, and return to its initial position by the other side. (5) The wheel M on the sewing machine shaft, combined with the lever B, provided at its end with a pad or brake, L, capable of striking said wheel on one side of a line vertical as to its centre, and the buffer, capable of striking said wheel on the other side of said vertical line, whereby a movement of said lever in the same direction may either stop or start said wheel, as set forth. (6) The levers A B, pivotted with same axial line and coupled together by offsets or lugs, S, in engagement when said lever A is moved in one direction, but disengaged when said lever is moved in the other direction, combined with the bumper C and pad L, on the lever B, whereby the machine may be stopped or started by a movement in the same direction, or the lever folded to be out of the way during storage or transportation.

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All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

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Established 1836.

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Of which paid up	300,000
Fire Reserve Funds	637,977
Life Funds, as per last account	£1,462,146

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ELECTRIC LIGHTING by INCANDESCENCE, and its Application to Interior Illumination: a Practical Treatise. By WILLIAM EDWARD SAWYER.

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ELECTRO-TELEGRAPHY. A Book for Beginners. By FREDERICK S. BEECHEY, Telegraph Engineer. Second Edition.

London: E. and F. N. SPON, 16, Charing-cross; New York, 446, Broome-street.

SUBMARINE CABLES TRUST.—NOTICE is HEREBY GIVEN that the COUPONS of the Submarine Cables Trust, due on 15th inst. (Good Friday), will be PAID on and after 16th inst. by Messrs. Glyn, Mills, and Co., 67, Lombard-street, between the hours of 10 a.m. and 2 p.m.

The Coupons must be left for examination three clear days before calling for payment.

LEWIS WELLS, Secretary.

66, Old Broad-street, April 8, 1881.

REQUIRED, second-hand medium size, or D2 SIEMENS DYNAMO-ELECTRIC MACHINE, with all the latest improvements. Address, stating price and where to be seen, "U. P.," care of STEEL and JONES, Advertising Agents, Spring-gardens, S.W.

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COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.

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TELEGRAPH AND ELECTRICAL ENGINEER,

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All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

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SLIP

SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—The next meeting of this society is fixed for May 12th.

THE TRANSVAAL.—The British authorities, it is stated, do not intend restoring telegraphic communication with the Transvaal capital.

CABLE REPAIRED.—The Compagnie Française du Télégraphe de Paris à New York inform us that their Brest-St. Pierre cable is now repaired.

EXTENSION OF TELEGRAPH LINE AT CARDIFF.—A new line is to be erected between Cardiff and Newport, running through the village of Llanbad.

THUNDERSTORMS.—During the recent hot weather several thunderstorms were reported from various parts of the country, but no damage appears to have been done.

ELECTRIC LIGHT AT THE GENERAL POST OFFICE.—Five powerful lamps have been fitted up in the centre room of the large building in St. Martin's-le-Grand as an experiment.

BRITISH ASSOCIATION.—Mr. Spottiswoode will read a Paper on the "Electric Discharge, its Forms and its Functions," at the meeting of the British Association, at York, on Monday, the 5th September next.

ROYAL INSTITUTION.—We notice that Professor Tyndall, F.R.S., is to give a series of six lectures on Paramagnetism and Diamagnetism, on Thursdays, commencing the 28th April, and ending the 2nd June.

ELECTRIC LIGHT AT THE HAGUE.—The land of water, which sounds Irish but isn't, has caught the fever. One of the shops at the entrance of the Arcade in the Hague is illuminated by means of the electric light.

ELECTRIC LIGHT AT AMSTERDAM.—The Continent is ahead of us in employing the electric light inside theatres. The proprietors of Carré's Circus illumine their proceedings every evening by means of its powerful rays.

A TELEPHONE EXCHANGE FOR PRESTON.—Our northern friends are fast adopting the telephone. We hear that an exchange is to be established in Preston, at No. 7, Fishergate. The scheme is being carried out by Mr. G. Sharples.

THE CRYSTAL PALACE.—An opportunity is about to be afforded for witnessing the experiment of enlisting electricity as a motive power, a line having been laid down in the Crystal Palace grounds by the Société Anonyme Electrique de Bruxelles.

SOCIETY OF ARTS.—A paper will be read on the 18th May by Mr. Alexander Siemens, on "The Electrical Railway, and the Transmission of Power by Electricity." Another paper will be read on the 26th May by Mr. Shelford Bidwell on "Telegraphic Photography."

TELEPHONE SHARES.—On Wednesday the 13th instant, the share list of the Consolidated Telephone Construction and Maintenance Company closed, the applications being about fivefold the number of shares to be allotted. The shares were dealt in at $\frac{3}{8}$ premium.

THE TELEPHONE AT ASHTON-UNDER-LYNE.—The Lancashire Telephonic Exchange Company are about to establish a branch at Ashton-under-Lyne. The Corporation have recently signed an agreement with them by which the company are to pay a rent of 2s. for each pole erected in the streets.

THE PROPOSED NEW CABLE TO SHETLAND.—Mr. Laing, M.P. for Orkney and Shetland, has received a letter from the Postmaster-General, in which he says that he declines to give a new cable to the Shetland Islands, on the ground that it would cost £10,000, and that the traffic would not recoup the outlay.

GLASGOW CORPORATION AND THE TELEPHONE.—The committee appointed to reconsider the recent decision of the Corporation not to permit Messrs. Graham to erect poles for a telephone line on certain property have agreed to permit their erection provided Messrs. Graham obtain the consent of the lessee of the property, and also provided that they are removed whenever he wishes it.

PRICES.—The prices as quoted are:—For gutta percha, per lb., genuine 4d. to 3s. 3d., reboiled 3d. to 1s. 3d.; for india rubber, per lb., Para, fine, 3s. 5½d. to 3s. 6d., negrohead 2s. 5d., central American 1s. 11d. to 2s. 6d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d. Last week's market is reported as flat and without business.

SOUTH AMERICA.—We are informed by the West Coast of America Telegraph Company (Limited) that telegraphic communication is now re-established with all their stations between Valparaiso and Lima (Serena, Caldera, Antofagasta, Iquique, Arica, Mollendo, Callao), and that messages can now be received at the various telegraph offices for transmission to any part of the West Coast of South America.

SWAN'S LAMP AT GATESHEAD.—On Friday last four of the Swan lamps were lit up in front of the Town Hall. The engine is by Messrs. Black, Hawthorn, and Co., and is of very small size; it is placed in West-street, from whence the wires run under ground to the Town Hall. We learn that the Swan Electric Light Company have engaged some buildings at Benwell as a manufactory for their lamps.

INDO-EUROPEAN TELEGRAPH COMPANY.—The fourteenth ordinary general meeting will be held at the New Exchange Buildings, George-yard, Lombard-street, on Thursday, the 28th of April, at twelve o'clock noon precisely. The transfer books will be closed from the 14th to the 28th of April, both inclusive. Coupons held in this country must be deposited at the company's office three clear days before payment, for the purpose of verification.

L'ELECTRICIEN.—We have at last received the first number of this long-promised paper, and now that it has appeared we do not find much that is new in it. We must confess to having thought that electrical science was sufficiently represented in France by our contemporaries, *L'Electricité* and *La Lumière Electrique*. We fear that this multiplication of electrical journals, so far from assisting the student, will only embarrass and discourage him.

TELEGRAPHIC EXTENSION IN BUTE.—There is every probability that the petition to the Postmaster-General the other day will be granted, as we hear that a Government official has been down inquiring into all the circumstances. The Marquis of Bute is said to be in favour of the extension, and has expressed a desire that if possible the line should be made to pass *viâ* Mountstuart, with the view of having his new mansion connected with Rothesay by telegraph.

THE ELECTRIC LIGHT AT DRONFIELD WORKS.—These steel works, belonging to Messrs. Wilson and Cammell, were lighted up for the first time by electricity on the 13th April. The system used is the Brush. There are eighteen lamps in use, and it is proposed to add to this number. One lamp serves to light the whole of the Bessemer engine house, which is a large building. We learn that several other Sheffield firms are thinking of adopting the light for their works.

ELECTRIC LIGHT AT GREENOCK.—On Thursday evening last the steamboat quay was illuminated for the first time by the electric light. There are four separate generators, one

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for each lamp, which are driven by a small portable engine. The system used is the Brush, under the charge of Mr. Crompton. There are four lamps fixed on the top of poles 54 feet high, one at each end of the two long sheds on the quay. The lights, with one exception, burnt well, and gave great satisfaction. Vessels will now be able to load and discharge during the night.

THE TELEPHONE IN VIENNA.—The Vienna Local Telegraph Company has applied for and has been granted a concession to establish telephonic communication in the city. In granting the privilege the Government has made two conditions—firstly, that the subscription should be as low as possible; and, secondly, that telephonic communication should in certain cases come under control, as is the case with telegraphic communication. The first condition has been fulfilled already by the company intending to limit the amount of subscription to from 100 to 140 florins a year.

THE NICE CATASTROPHE.—NUMBER OF TELEGRAMS DESPATCHED.—A correspondent of *L'Electricité* says that the number of telegrams despatched and received during the two days following the burning of the theatre reached 25,000. As there is but one wire between Nice and Marseilles, the greater part of these were sent by rail from Nice to Marseilles, and *vice versâ*, causing a delay of several hours. *L'Electricité* is astonished that the means of communication between two such important places is so bad, and wishes the French Government would take a lesson from the English.

ELECTRIC LIGHT AT NOTTINGHAM.—The Brush electric light was brought into requisition for illuminating Nottingham Castle on Easter Monday. A portable steam engine of 10 horse-power, placed near the entrance to the moat, furnished the power, the current being conveyed by a wire 1-7 inch thick. There were sixteen lights in all, two being placed on ordinary lamp-post pedestals on the edges of the Castle-green, one at the entrance to the castle, and the remaining thirteen over the staircases and in the various galleries. With the exception of three placed in the Long Gallery the eight worked well. Each light was of 2,000 candle-power.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—We have received a copy of the *Journal*, No. 35, Vol. X., for March, and amongst the contents are:—Mr. Heavisides' paper on "Induction and the Telephone," Mr. Adams's paper on "Earth Currents," and an original communication from Mr. J. T. Wilmot on a "Manual Translator," and an "Automatic Double Current Translator." Besides these there are abstracts of papers in foreign publications. The number also contains a revised list of members, which shows a total of 981, composed of honorary members, 4; foreign members, 152; members, 339; associates, 475; students, 11.

PROFESSOR HELMHOLTZ.—At Dublin on the 13th inst. the degree of honorary Fellow of the College of Surgeons was conferred upon Professor Herman L. F. Helmholtz, the eminent scientist of Berlin University. The ceremonial took place in the board room of the college, Stephen's Green, in the presence of a large number of fellows and students. The president of the College (Dr. Maclintock) delivered a brief address, in the course of which he adverted to Professor Helmholtz's high scientific attainments. The privilege now offered had been only five times before accorded to foreigners. The Senate of Dublin University also conferred on Professor Helmholtz the degree of LL.D.

CITY AND GUILDS OF LONDON INSTITUTE.—We notice that the work of this institute recommences on May 2, when Dr. Armstrong will deliver the first of about thirty lectures on "Organic Chemistry." On May 3, Professor Ayrton commences a course of lectures on "The Application of Fundamental Electrical Principles to the Proper Construction of Statical Electrical Apparatus." On May 6, Professor Ayrton will commence another course of lectures on "The Electric Light." Besides these evening lectures, Professor Ayrton has classes for laboratory work, and also day lectures and laboratory courses. Any information relating to these classes can be had on application to the director at Gresham College, E.C.

SUBMARINE DEFENCE.—Comprehensive schemes of submarine mining defence are being carried out at a number of our military stations, including Gibraltar, Malta, Halifax, Bermuda, Esquimalt, Sydney, West Indian Islands, Hong Kong, Singapore, and Ceylon. The chief feature of the system adopted consists of a chain of sunken mines of two descriptions—viz., those which explode upon contact with a vessel, and ground mines which are discharged by electricity from the shore at the moment of the vessel passing over the spot. In order to carry out this last object the exact points at which the ground mines are to be placed are clearly laid down and known to the Commanding Royal Engineer at the station, and can be discharged at the fitting moment.

A NEW OBJECTION TO THE ELECTRIC LIGHT.—A report reaches this country, we know not from whence, that young ladies employed in establishments where the electric light is used complain that it injures their complexions. The injury consists in giving them the appearance of being sunburnt, and promoting an eruption of freckles. Ladies may regard these as disfigurements, but we beg to assure them that their admirers of the other sex do not. One young man of our acquaintance who, being prevented by impecuniosity from going to the seaside, spends his annual leave on his back in the park, has now resolved to take his stand every spare evening under a Siemens lamp post. Henceforward he hopes to wear a bronzed and travelled aspect all the year round.

TELEPHONIC.—We understand that Messrs. David Moseley and Sons, telegraph engineers and india rubber manufacturers, of Manchester, have succeeded, after experiments extending over upwards of twelve months, in finding and adapting for telephonic transmitters a material which will replace carbon with advantage. We are not yet at liberty to say what the substance is, but we have reason to believe that, as it possesses greater conductivity than any other non-metallic body, carbon not excepted, and a greater variation of resistance under variations of pressure than carbon, the new transmitter will be found to excel the existing carbon arrangements. The material is said to be harder and therefore more durable than carbon. Patents have been applied for in various countries, and as soon as these are granted we shall have something more to say on the subject.

UNDERGROUND WIRES.—At a recent meeting of the Sheffield Town Council, the question of underground *v.* overhead wires was gone into, with special reference to the application of the Telephone Exchange for leave to fix a microphone in the clock tower of the Town Hall. One of the members of the Council moved that "so much of the acts and proceedings of the Watch Committee as relates to the affixing of wires to the Town Hall clock tower be not approved, but that the Watch Committee be instructed to inquire as to the telephone apparatus fixed by Messrs. Tasker, Sons, and Co., and to ascertain the strength of the wires, the strength of the supports, the dis-

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tance between the posts, and whether the wires were covered or not." In some further remarks he also pointed out the danger of wires unprotected by gutta percha or other covering being eaten away by the acids to be found in the air of large manufacturing towns, thus rendering serious accidents possible. His opinion was that the supports were not strong enough, and the distance between the supports were too great. This motion was agreed to.

Battery Experiments at Nantes.—*La Lumière Electrique* gives some statistics of the E.M.F. and resistance of the batteries used between Nantes and Paris and Nantes and Bordeaux, the testing taking place on the 20th Sept., 1879, and 11th Feb., 1881, or at about 16 months interval, during which period the cells remained unchanged. Here are the figures:—

No. 1 Battery.

Paris Line.	E.M.F. in Callaud Cells (large size).		Resistance of each couple in Siemens Units.	
	Sept. 20, 1879.	Feb. 11, 1881.	Sept. 20, 1879.	Feb. 11 1881.
12 Chutaux cells (bichromate of potash)	21	20·5	14	60
12 Callaud cells (small size)	12	11	37	102
12 Leclanché cells	16	13·5	4	6
12 Marié Davy cells	15	17·5	19	43
12 Beaufils cells (mixed salts)	16	17·5	6	9
12 Beaufils cells (agglutinised salts)	16	17·5	10	15

No. 2 Battery.

Bordeaux Line.	E.M.F. in Callaud Cells (large size).		Resistance of each couple in Siemens Units.	
	Sept. 20, 1879.	Feb. 11, 1881.	Sept. 20, 1879.	Feb. 11, 1881.
12 Chutaux cells (charged with solid produce)	21	21	14	49
12 Callaud cells (large size)	12	12	100	70
12 Leclanché cells	16	15	4	9
12 Marié Davy cells	16	17	18	76
12 Beaufils cells (mixed salts)	16	16	5	10
12 Beaufils cells (agglutinised salts)	16	16	8	22

As will be seen, the E.M.F's. of these batteries were fairly constant; but the resistances of some were greatly increased; the bichromate batteries, however, behaved best as regards their E.M.F. We should say that the measures were taken by groups. The E.M.F. was determined by the method of opposition, viz., by opposing to the 12 cells experimented with so many Callaud cells (large size) as were found necessary to annul their E.M.F., and the resistance R was reckoned by Poggendorf's method, using the formula:—

$$R = \frac{E\,W}{e} - W,$$

E representing the E.M.F. of the battery experimented with, e that of a small Callaud battery of four cells serving as a method of comparison, W the resistance developed by the rheostat to bring the deviation of the galvanometer to zero. Thus the figures represent the total resistance of each group of cells.

Experiments on the Difference of Potential of two Metals in Contact.—By H. Pellat.—The author used his apparatus, described in Vol. IX., p. 145 of the *Journal de Physique*, and abstracted in Vol. IX., No. 33, p. 326, of this journal, to determine how the apparent difference of potential depended on the superficial layer of substances opposed to one another. A plate of copper was chemically cleaned, and found to have electromotive force of contact with gold equal to 0·137 Latimer Clark cells. The copper plate was placed for an instant in sulphuretted hydrogen gas and then washed again in alcohol, but the electromotive force of contact with gold had gone up to 0·201. Experiments were next made with a plate of zinc with gold, and it was found that the electromotive force of contact, which was 0·698 just after the zinc had been most carefully cleaned, diminished to 0·523 in a quarter of an hour, the plates being in the air and no visible alteration having occurred at the surface of the zinc. The effect of rubbing the surface of the zinc in different ways was next tried, and the author arrived at the result that all metals became more positive when the surface was rubbed; that this effect died away slowly if the scratching had been deep when emery paper was used, and more quickly if the rubbing had been less deep, filtering paper being only employed in the cleaning. Zinc showed the greatest change with the mode of cleaning the surface, and copper the least. Experiments were next made on the effect produced by altering the pressure of a gas surrounding the plates, and which was chemically inactive; the results arrived at were that the difference of potential increased with diminution of potential, and regained its original value when the pressure was again increased, the greatest change in any case obtained being not more than 1-25th of the total difference of potential. A curve is given showing the variation of difference of potential with variation of pressure when the gas surrounding both plates was oxygen. The author found that the substitution of one gas for another produced little change when the pressure was small. The author next investigated whether two metals joined by a liquid arc were at the same potential, and he considered it important in this experiment that the surfaces opposed to one another and acting inductively on one another should be those that are joined by the liquid. As, however, the difference of potential changes with time, and as it was the first difference of potential he desired to measure, the time law of change was determined by several experiments, and thus the initial difference of potential arrived at by interpolation. The conclusion arrived at was that joining two metals by alcohol reduced at the first moment the surfaces touched by the alcohol absolutely to the same potential, a conclusion that can be usefully employed in determining the difference of potentials of rare metals that cannot be obtained in plates. —*Abs. from Jour. de Phy. in Jour. of Soc. of Tel. Eng.*

Electricity for Mining Purposes in the Forest of Dean.—During a period of some three years the Trafalgar Collieries in the Forest of Dean, belonging to Messrs. T. B. and W. B. Brain, have been lighted both by night and early during the successive mornings by means of the electric light. More recently Mr. Blanch Brain has greatly increased the utility of this mode of lighting under a design of his, the outcome of which is that a special lamp has been provided for the *employés*, the main feature being its great simplicity. The lighting feeds directly upon the carbon, and is thus ensured constant and regular, the resistance of the lamps never varying. Then the consumption of carbons has a further important feature in the fact of waste being minimised. In other words, the economical advantages are so fully attained that not more than half an inch of waste arises, and the rods are put in always half metre at a time. The lamps possess a further advantage in so far that they can be fed at any time with fresh carbons without affecting the light; hence the lamps are capable of continuance of burning for three or four days without cessation or the extinguishing of the light for the shortest period. As the exhausted carbons present themselves others automatically take their place, something

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like one cartridge following another in a Winchester rifle. Mr. Blanch Brain has eschewed or ignored the introduction of the typical clockwork in connection with his lamps, the mechanical appliances being, as already stated, of the simplest character. The lighting is regulated by a small "pawl" acting on a fine steel ratchet. It is made in two forms, the one vertical and the other horizontal. Five of these lamps are employed within a small circuit—an area covering the *locus in quo* of Messrs. Brain Brothers' colliery banks, inclusive of the offices, &c., mainly centralised towards the pit shafts. But the principal feature that has been carried on at these works, and more especially the subject calling forth this notice, is the important and exceedingly interesting development of electricity in regard to the transmission of power. The motor is Mr. Brain's own construction, and patented by him in 1878. Both the field magnets and the inducing magnets are made circular. The diameter of the small machine is 18in., and the width 8in. from out to out. From out to out of the stand is 2ft. in length and 2ft. in height. This machine gives a power of about 3·97 h.-p. when driven by an ordinary A Gramme dynamo. There is a larger machine of the same construction, which is expected to yield proportionate results. In the course of a few weeks Mr. Brain hopes to have perfected his arrangments sufficiently to ensure a set of this kind of apparatus being at work to the extreme end of the colliery workings at Trafalgar, which is more than a mile from the surface. Our correspondent adds:—I saw several A Gramme machines, some small pillar Grammes, and a fine E Gramme, lent by the British Electric Lighting Company, of Regent-street, London, which enabled Mr. Brain to further develop his interesting and valuable experiments. He has also been using Professor Siemens's machines for the past four years. I was also shown a winding apparatus, especially constructed for this electrical arrangement, and likewise a small pumping apparatus. It is contemplated extending this system upon a large scale, in order to meet the difficulties at these collieries which are said to have arisen, and been thrown upon the firm, in consequence of an inundation.—*Colliery Guardian.*

How the Telegraph is Kept in Order.—Everyone has seen a "line man" walk up a telegraph pole as readily as if he were going up a flight of stairs. With a quick, nervous jerk of the foot he drives the spurs into the wood, and takes a firm hold every time. This dexterity comes from practice. It looks dangerous when a man is near the top of the pole, but that there is really little danger is proved by the fact that accidents very rarely occur. The men become accustomed to working at a great height, and mind it no more than sailors on a ship. An experienced man looks out for rotten poles and cross beams, and, once confident of these, he feels no further alarm. He hangs on by his legs as cleverly as a monkey by its tail, and thus has the free use of his arms and hands. The spurs are of steel, and consist of a flat bar with a bend, which passes under the instep. A sharp point projects diagonally downward, so as to bear a heavy weight from above. The greater the weight the deeper the point sinks, and the wood would have to be very rotten for it to slip. It leaves behind on the pole those queer little holes which so much resemble the work of a woodpecker on a tree. The line men are divided into two classes, climbers and ground men. The latter rank little higher than ordinary labourers; but in time, if they are ambitious to learn, they graduate into climbers. Climbers are paid from 40 to 75 dollars a month, and at present are in great demand owing to the large amount of telegraph construction going on throughout the country. Ground men dig holes, plant poles, carry wire, and do whatever other labour is necessary. The climber is provided with a pair of pliers, a hand vice, and a strap. He catches the broken ends of the wire, draws them together with the vice and strap, and splices them with the pliers. Care is taken to leave a certain slack, so as to allow for contraction by cold in winter. In large cities a number of climbers are kept constantly on duty at the central office, so as to be sent out at a moment's notice to repair a break. If a pole falls, prompt action is taken. The fallen portion is chopped into sections, and dragged out of the way of traffic. The stump is dug out. If a hole is to be dug, it is bored with a great earth-auger, which does its work more neatly and quickly than spades. There are different ways of raising the poles. If it is a very long pole—say 70 feet—a short pole is temporarily inserted and used as a guide. These long poles are becoming common in the city, for the reason that they raise the wires above the great mass of wires that cover the streets with a network of iron. Smaller poles are raised with pikes. A slanting ditch is dug from the surface of the ground to the bottom of the hole. The pole is laid in this, and this raises the upper end from the ground. Eight or ten men with pikes get under it. These pikes are long, smooth poles with a sharp spike in the end. The men drive the spikes into the under part of the pole, and raise altogether. They stand in such a way that the centre of gravity of the pole falls among them, and there is no danger of its toppling to either side. Of the ten men eight will retain the advantage gained by the lift. The other two loosen their pikes, and going in front of the others, insert their pikes lower down. Another lift is given, and this process is continued until the pole is raised to a perpendicular. The earth is then firmly wedged in about it, and it is ready to receive the wires. The wires used are generally of size No. 8. For very long circuits Nos. 6 and 4 are used. The Western Union Telegraph Company has two No. 4 wires running to Chicago. The insulators are of glass, and cost from three to four cents. a-piece. If a break occurs the operator calls each station until he has succeeded in locating the break. He then orders out the line men to find it. It is easy to do this in the city, where line men are constantly on the look out; but in the country it is a different thing. Line men, who are necessarily climbers, are engaged by the month, and have each a certain tract of line assigned to their care. If the lines run along a railroad a man has control of an average of fifty miles. In case of a break he travels on a baggage or hand car to the place. If the line runs on a turnpike, away from a railroad, the line man has only fifteen miles under his care. He is obliged to live within call of the nearest station, and to be ready to go out at any time. Night or day, hot or cold, he must be prepared to start for the scene of trouble. The lines often run through desolate places, on the sides of mountains, and in wide prairies. The line man, on horseback, dashes from pole to pole, following the wires with his practised eye. He often camps out all night, for he must not stop until the work is completed. In the winter some of these men travel on snow shoes, and lately, out West, they have had the strange experience of digging down to the wires, where the snow was so deep as to cover the poles. The poles are generally of two kinds, cedar or chestnut. Cedar is the lightest, trimmest, and best looking, but chestnut lasts longer. Wires last from six to eight years. Rust is their great enemy, and smoke another foe. Neither wires nor poles are expensive. Labour is the great item in making repairs, and in times when there is universal disaster to lines the companies have to pay high wages.—*New York Sun.*

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THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

At the meeting of this society, held on Thursday, the 14th inst., Professor FOSTER in the chair, Mr. ST. GEORGE LANE FOX delivered an address upon "The Application of Electricity to Lighting and Heating for Domestic and Other Purposes." The lamp invented by Mr. Fox has been fully described and illustrated in these columns,* together with his device for regulating the engine by an electrical automatic shunt connected with the steam valve. A similar end might be attained, Mr Fox thought, by connecting the shunt with a rheostat, which he described. Diagrams of his new methods of exhausting the globes were also exhibited, and were shown to be both simple and efficient, besides being far more expeditious than using the Sprengel pump. Some calculations were gone into as to the cost of the light as compared with that of gas, showing that when supplied on a large scale the economy would be very much in favour of electricity. The lecture room was lighted by a number of Mr. Fox's lamps, which were grouped in threes, and enclosed in globes similar to those exhibited by Mr. Swan. The illumination was satisfactory, and showed that marked absence of dazzling white rays so commonly complained of in the arc systems. The carbon filament was estimated as offering a resistance of 150 ohms, which was reduced to 80 ohms when heated. They were indestructible if kept under a certain temperature—a temperature, say, giving 150 candle-power light. Such a light consumed 1 horse-power, and his calculations of cost were estimated on this basis. A brief explanation of his heating apparatus supplied by electricity concluded the discourse.

Professor AYRTON then described a portable absolute galvanometer for strong currents, invented by Professor Perry and himself for the use of their students at the City and Guilds Institute. The many defects of similar instruments now in use were commented upon, and the superiority of this new device was very conspicuous. We hope to be able to illustrate this handy and useful instrument; but its main feature consists in the employment of a strand or little cable of wires, which can be used either in parallel circuit or in series. The needle has a dead beat, the value of the current is told off without calculation, and if the magnet is suspected of falling off in power the instrument can be recalibrated with the utmost ease.

Professor AYRTON described also a novel form of mechanical dynamometer, which gives off readings at all times, being permanently affixed to the engine shaft, and its action governed by the speed of the revolutions, or rather by the strain upon springs connecting the shaft and pulley. In the discussion which followed, Mr. COMPTON mentioned that a juvenile friend of his had contrived a dynamometer exactly similar to this in principle though differing in details, and that it had been in actual use for twelve months past. He should, however, certainly procure one of Professors Ayrton and Perry's galvanometers.

Mr. D. CHADWICK, as representing the general public, wished to know, first, what were the special advantages of Mr. Fox's system over that of his competitors; he was also especially curious as to what would be the cost, for example, of supplying his country house with a light such as he saw before him? Another gentleman, whose name did not transpire, asked what security we had against the failure of the engine, or of the straps connected with it.

Mr. CROMPTON reminded the audience that the actual cost of any given undertaking was no criterion of what the cost would be if the system were adopted generally or largely. As to relative merits, they were all running an honourable race, and it was for the public to decide whose system they liked best. He thought, however, that Mr. Fox's method of employing the multiple arc connection was wasteful. He (Mr. Crompton) had made calculations with Mr. Swan's lamp, and found that, compared with connecting in series, their capacity was as 10 to 18. He also thought that Mr. Fox was in error as to the resistance of his carbons when heated. Sir W. Thomson had shown that 150 ohms resistance was reduced to 50 when in a state of incandescence.

Mr. C. G. GUMPEL, C.E., thought there was nothing to choose between Mr. Edison's, Mr. Swan's, and Mr. Fox's lamps, and that Mr. Edison had priority in point of date. As a practical engineer he could not accept Mr. Fox's estimate of cost, for he had fixed the consumption of coal far too low. Even for the largest engines the consumption of coal was about double the estimate named by Mr. Fox, whilst for the engines commonly used for driving electric generators the consumption was four or five times as much. It was better that the facts should be frankly made known, and he deprecated any secresy which might have the effect of shaking public confidence in the statements of electric lighting promoters.

The discussion was then adjourned until the next meeting, which is fixed for May 12th.

* *The Electrician*, March 5th, 1881.

LAYING AND REPAIRING SUBMARINE TELEGRAPH CABLES.*

BY A. JAMIESON, C.E.

(CONTINUED FROM PAGE 278.)

The lecturer then described the apparatus of Sir W. Thomson used in taking soundings, thus:—

The work of taking a cast by Sir W. Thomson's patent sounding machine is done by two men, under the superintendence of an officer. For brevity, the men will be referred to as brakesman and leadsman. The regular post of the brakesman is at the starboard side of the sounding machine. The regular post of the leadsman is beside the taffrail fair-lead. The men go to their posts, and without further orders the brakesman lifts the machine out of the box, and runs it forward into position, and secures it in position by turning down the two iron struts. At the same time the leadsman places the lead, properly armed, and the sinker and sheath lying in convenient positions near the taffrail fair-lead; then goes to the machine, unhooks the depth-gauge, pulls it away from the drum, till a convenient length of the cord is wound off, and then, carefully preventing the cord from slacking between his hand and the wheel, shows the depth-gauge to the officer, to see that the glass tubes are empty, and to have them properly closed by the screw. The leadsman then places the depth-gauge in the sheath, securing it by the split pin, and then places the cord over the fair-lead, allowing the depth-gauge to hang from it close up to the taffrail. Before he takes his hand from it he calls "on brake." The brakesman instantly puts on the brake and calls "brake on," and then immediately goes aft to help the leadsman to let down the lead without a jerk till it hangs upon the sheath and depth-gauge. He then returns to the brake and eases it slightly, while the leadsman, with his hand applied to the cord and link coming off the wheel, prevents it from going out too fast until the link has passed over the fair-lead. The leadsman then calls out "on brake," and on the brakesman answering "brake on" he takes away his hand from the link and calls out "ready."

When the officer is satisfied that all is ready he goes to the port side of the machine, and takes the brass finger-pin†, and, holding it lightly by its handle, presses it against the wire about two feet from the wheel, and gives the order "let go." The brakesman instantly pulls up the heavy brake-weight by the hand rope, and holds it up until time to stop. While the wire is running out he listens attentively for the officer's order to stop, and at the same time watches the counter. He calls out smartly, as the hand passes the successive numbers, "50," "100," "150," "200," and, unless stopped sooner, "250." If he has not heard the officer's order to stop before coming to 250, and if he is not specially ordered to let the wheel run beyond the 250, he commences applying the brake instantly after calling out 250; stopping the wheel by pressing on the brakeweight if necessary, and making quite sure not to let the counter reach 300. While the wire is running out, the officer keeps pressing it as steadily as possible with the brass pin until he suddenly feels it slacken, when he calls "stop." The brakesman instantly begins easing down the brake gradually, and while doing so he reads off the counter. If the wheel does not stop when the whole force of the brakeweight comes on it, the brakesman must press down on the top of the brakeweight until he stops the wheel. Meantime the leadsman applies the handle on the port side of the machine, and when he has got it secured he commences pressing the handle in the direction to wind in. As soon as the wheel is thus secured by the leadsman, the brakesman takes his hand from the brake, applies his own handle to the wheel, and then slacks the brake, and the two commence winding in.‡

The leadsman winds with his left hand and guides the wire to the drum with a piece of waste canvas wet with lime water and

* A Lecture delivered at the Naval and Marine Engineering Exhibition, Glasgow, January 28, 1881.

† The brass finger-pin is supplied with the machine, but if it should be missing or lost a piece of hard wood will do to press on the wire while the sinker is going to the bottom.

‡ When the speed exceeds ten knots it is desirable to have another man to help in the winding. He is to stand looking aft, and to work with both his hands on the port handle, the leadsman working on the same handle with his left hand.

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mud of quicklime held in his right hand. The brakesman, winding with both hands, watches the counter from time to time during the winding in, and when the link is five fathoms from the fair-lead, he calls out "Hand the lead." The leadsman instantly leaves the machine, goes to the taffrail, and steadies the link and cord by his hand as they come up, and guides the link over the fair-lead; while the brakesman continues slowly winding it until the link reaches the wire drum, and placing it properly on the wire drum he winds in one turn more; then, taking care that the link is a little above the middle of the after side of the drum, so that its weight may help to keep the wire stretched, he puts on the break. Meantime the leadsman hauls by hand on the horizontal part of the cord till the depth-gauge is close up to the fair-lead, and holds it so till the brakesman comes for it. The brakesman, as soon as he has secured the wheel by putting on the brake, goes aft and takes the sheath of the depth-gauge in his hand. The leadsman then pulls up the lead, examines the arming for specimen of bottom, shows it to the officer, and prepares the arming for a fresh cast, and then goes forward to the machine and stands by on its port side. The brakesman, lifting the cord off the fair-lead, takes the depth-gauge out of its sheath and shows it to the officer, who examines the tubes and takes the proper reading for the depth. The brakesman opens the tubes below and empties them, and hangs the gauge on its hook on the after side of the machine box. He then takes the starboard handle in his left hand, slacks the brake by his right hand, then, keeping the plaited cord tight by his right hand, turns the handle twice round and stops the wheel once more, with the link a little above the middle of the after side. Holding the wheel in this position he takes off the starboard handle, and at the same time the leadsman takes off the port handle. Then the brakesman takes the top bar of the machine in his left hand, prevents the wheel from going round by pressing his third and fourth fingers on the rim, with his right hand turns up the struts, then lifting by his left hand, and guiding and shoving aft by his right hand placed under the horizontal bar of the port side of the framework, shoves the framework aft, and then lets down the machine till the wheel is completely submerged under the lime water in the box and puts on the lid over it, thus completing the operation.

Fig. 1 shows the machine with the small weight A resting on the long weight W, and the brake cord B slack as it is when the wire is being wound in. To put on the brake, lift the long weight W by the hand rope E and place the small weight A in the recess in the large weight, and then slack the hand rope again. While a sounding is being taken the long weight W is held up by the rope E, so as to allow the small weight A to hang freely. As soon as the sinker reaches the bottom the brake is put on by easing the rope E and allowing the weight W to be supported, by means of its jaws, on the small weight A. The whole weight of W should not be allowed to come suddenly on A, but it should be eased down gradually. If when the whole weight of W is resting on A the wire still continues to run out, the brakesman should press his hand down on the top of W until he stops the wheel.

Fig. 1

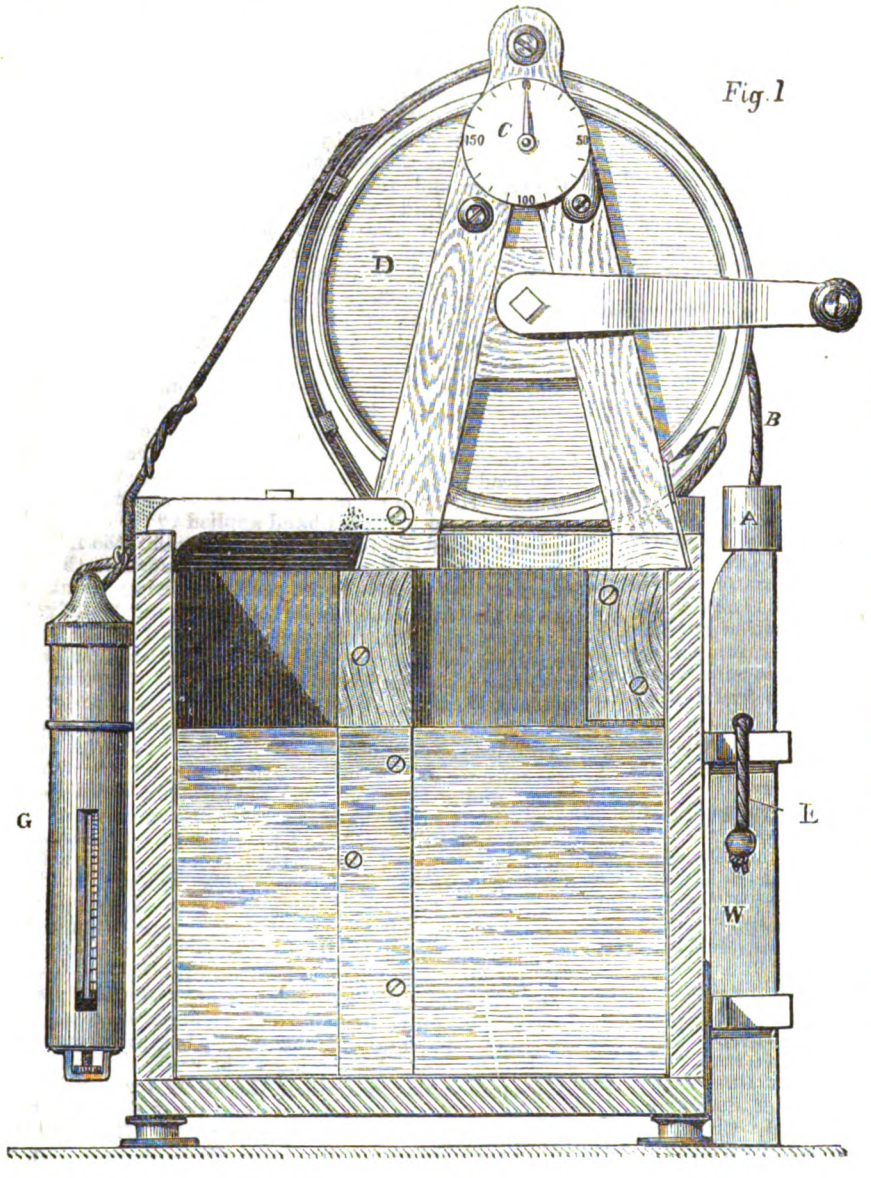
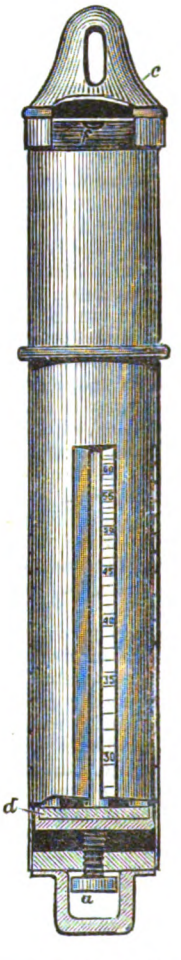


Fig. 3.

Fig. 2



Figs. 2 and 3 are drawings of the depth-gauge. Fig. 2 is the complete gauge, and Fig. 3 is a drawing showing the inside tubes. *a*, Fig. 2, is the screw for screwing up the valve *d* against the ends of the three glass tubes g^1, g^2, g^3. Before the gauge is allowed to go down it should be examined to see that there is no water in any of the tubes, and then the valve *d* should be closed by means of the screw *a*. The inside tubes can be taken out of the case by unscrewing the top of the case *c*. At *f* a small piece of the case is cut away to facilitate the getting of the tubes out. At the bottom of the brass tubes b^1, b^2, Fig. 3, there is a piece of very

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fine strong cotton or linen cloth. If it becomes necessary to renew this the tube must be heated gently to soften the wax on the screw of the brass tube, and the cap screwed off. A fresh piece of cloth can then be tied on and the cap screwed back to its original position and fixed with a little bees-wax or lard. If there is a difficulty in starting the cap it may be done by binding a piece of twine twice round it and tightening it by pulling on the ends and pressing the brass cap with a finger or thumb applied to it where the twine is round it.

Fig. 4 shows the sounding machine fixed on board a ship with the stern pulley on the taffrail. Between the sinker and the depth-gauge there is two fathoms of *plaited* rope, and between the depth-gauge and the link at the end of the wire there is two

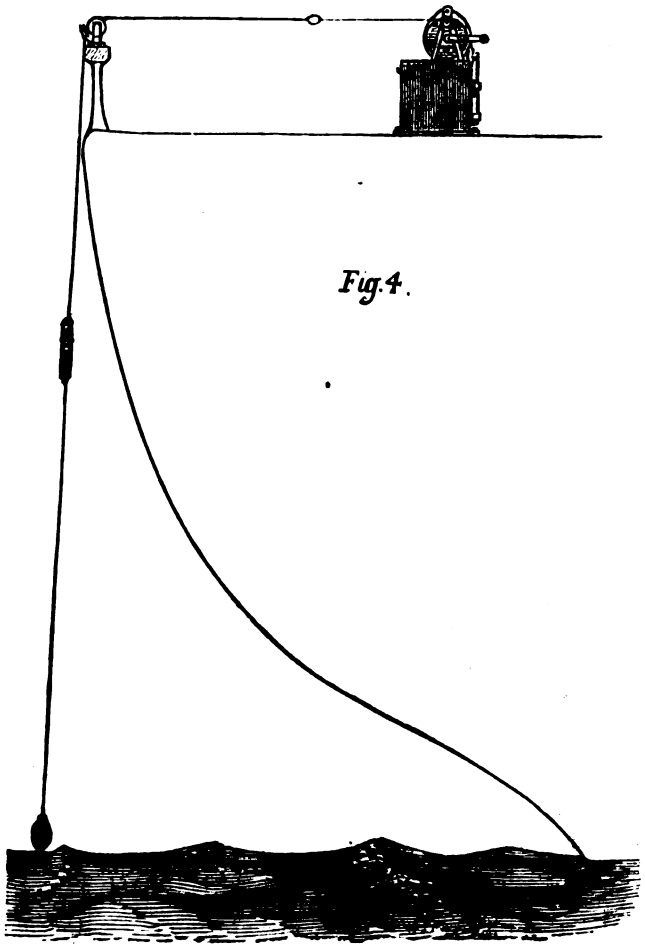
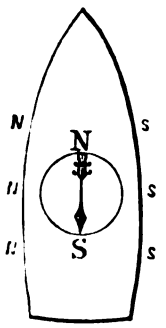


Fig. 4.



fathoms of *plaited* rope. It is very important that this rope should be plaited, *not twisted*. If twisted rope is used the turns from the rope go into the wire and it becomes very liable to kink.

However perfectly free from rust the wire be kept, it will break at a kink under a very moderate pull. Absolute security against kinks would be had if the wire could be prevented from ever slacking. It does slacken somewhat the moment the lead touches the bottom, but not to a dangerous degree if the ship is going at anything more than five knots, and if the brake is instantly applied when, by the wire's yielding to the brass pin, the commencement of slacking is shown. The brake, according to instructions, Art. 6, should be instantly applied, so as to slow the motion of the wheel, but not with force enough to stop the wheel suddenly. There is much more danger of losing the wire through a kink in taking an up-and-down cast than in a flying cast with the ship running at 12 or 14 knots.

If the wire is never left a minute out of lime water except when in actual use, and if the instructions be faithfully fulfilled, the wire will be as fresh and bright after years of use as it is when freshly supplied with the machine. After twenty years of use it is probable that it will not be sensibly weaker than when new. Look into the box often enough, when the machine is out of use, to see that the lime water covers the top of the wire on the wheel. Pour in a little fresh water from time to time to secure this condition. Dip a finger in the lime water, and taste it with the tongue occasionally, to make sure that it has the acrid taste which shows it to be really lime water. A piece of litmus test paper may be used, but the tongue is really a sufficient test. Once every two or three months, take out a handful of mud from the bottom of the box, and drop in a lump of unslaked quick-lime.

When a new machine is to be set up on board ship, the parcelling round the wire must not be removed until the box is filled with lime water. This is to be done by first lifting the machine up, and securing it in its upper position by the iron struts, and then placing three or four lumps of quick-lime on the bottom of the box, about the middle of the two short sides; then filling the box up to within about six inches of its top with fresh water. As soon as the lumps of quick-lime are found to have crumbled down, the water should be stirred sufficiently to mix the lime solution all through it. The machine may then be let down into the lime water. A little fresh water must be added if necessary to cover the wheel.

After the machine has been in water for a short time, it should be lifted up again, and run forward, and secured by struts in its proper position for use, and the brake cord should be looked to to see whether it is of the proper length. It will be found to have shrunk considerably. If after stretching it by pressing on the brake weight it is too short to release the 3lb. weight perfectly for running out the wire, the cleat at its after end must be eased, and a little more length given. "Brake on" means that the heavy 50lb. weight hangs by its upper claws to the 3lb. weight. See that it hangs clear, with two inches to spare below its bottom, so that, when pressed to stop the wire drum against the heavy pull of the wire, it may not be checked. While the wire is running out the 3lb. weight is to hang clear on the cord, quite unhampered by the 50lb. weight. To slack the brake for winding in, the 3lb. weight is to be slipped forward from under the claws, and lifted and placed resting on the top of the claws of the 50lb. weight. The fair-lead should first be screwed to the taffrail in a position carefully chosen to be as convenient as possible. The box of the machine, with its feet screwed to its deck plates, should next be placed on the deck in a convenient position, if possible within six or eight feet of the fair lead, and set so that, with its length exactly fore and aft, the middle of the wire drum shall be exactly in the fore and aft line from the middle of the fair-lead pulley. The places of the deck plates should then be marked on the deck, and the plates should be securely screwed to the deck by brass wood-screws in these positions. A proper place should be made in the neighbourhood of the fair-lead for permanently keeping the sheath and lead, with guards to prevent them from rolling about. To make all ready for use, it only remains to loop the depth-gauge to the end of the plaited rope on the wire drum, and to hang it by the loop to the brass hook on the after end of the machine box.

When the depth-gauge is brought up from a cast, the depth is shown on one or other of the three scales of fathoms by water seen up to a certain height in the corresponding one of the three glass tubes; in the first, if the depth is anything from 11 to 28 fathoms; in the second, if the depth is anything from 28 to 62 or 63 fathoms; and in the third if the depth is anything from 62 to 126 fathoms. If the water is seen to fill up the first tube to anything less than the 28 fathom mark, take the reading on it as the correct depth, and disregard any water that may be seen in the second or third tubes. If the first tube is filled up as far as the brass sheath allows it to be seen, but not so the second tube, take the reading on the second tube and scale for the correct depth, and disregard any water that may be seen in the third tube. If both the first and second tubes are filled up as far as they can be seen, read on the scale of the third tube to find the correct depth. The presence of water in any of the tubes is shown clearly by the magnification by optical refraction of the black line at its back. After the reading is taken, the tubes are to be emptied by unscrewing the bottom screw, and pulling down the valve-plate by a finger if it does not fall down by its own weight. A little tapping is sometimes needed to cause the water to flow out of the tubes after their lower ends are opened.

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SCIENCE AND CULTURE.

The oft disputed question whether there is any necessary antagonism between culture and science has been forced upon public attention by two notable speeches, delivered just recently on subjects relating to the progress and functions of telegraphy. The one was a carefully elaborated lecture by a rising, and in many respects typical example of the scientist; the other, a few gracefully worded but unstudied sentences let fall by an American citizen, who although officially employed in the sphere of diplomacy is far better known as a man of letters. The professor of modern science was all confident, not only as to the certainty of its future greatness, and especially, as was natural, of the pre-eminent part that electricity would play in ministering to man's needs, but also concerning its essential fitness,—betraying no misgiving as to the unalloyed blessings that science would thus be able to confer upon mankind at no very distant date. The representative of literature also was filled with admiration at the achievements and the promises both of physical science and of engineering skill. In language almost poetical, but thoroughly natural from such lips as his, he referred to these enterprises with something of awe, and even of reverence. But at starting he made this seemingly inconsistent admission. He said, "although I am wanting in sympathy for some of the achievements of modern science, yet I confess," &c., that is to say, whilst his admiration was a concession extorted from him, admitting probably of some qualification, his want of sympathy was absolute and quite a matter of course.

It may be pertinent to the consideration of the true province of electrical science if we ask ourselves how it happens that such men as the author of the "Biglow Papers" avow themselves, in the frankest possible way, to be out of sympathy with it, as with scientific pursuits in general. Perhaps the answer that comes nearest to hand is as good as any other, and it will be found in the speech of the professional electrician. He went out of his way, for reasons no doubt thoroughly well appreciated by his audience, to have a fling at a certain professor of quite another stamp. If science and most of its doings were disparaged in the one quarter, Mr. Ruskin and all that he is commonly supposed to represent were disparaged in the other. Friendship or sympathy cannot well subsist between parties so ready to speak slightingly of each other; and perhaps the fact that they do persistently so speak will in a large measure account for their mutual want of sympathy. It would be idle, however, to deny that there are other and graver reasons for the feelings which each entertains for its rival than those arising out of divergence of pursuits or even of competitive fault-finding. We fear it must be admitted as a fact that they mutually and very heartily mistrust each other. It would be difficult to find an example in literature of denial to science of its due and fitting vocation; and it would perhaps be equally difficult to cite an instance of science deliberately gainsaying the true mission of letters. But in these latter days, more conspicuously than in any that have preceded them, science has presumed to travel alone. Art has consequently protested that science is going the wrong road, or, perhaps, to be more correct, is pursuing it in the wrong fashion, unenlightened by the refining influence of art. Add to this the undoubted fact that the modern votaries of science are strongly utilitarian both in tone and temper, and we have before us all the conditions for driving them and the advocates of culture wider and wider apart. Science is unquestionably followed for its own sake by very many; but it has ceased to be the fashion to defend it on that ground, and it is even accused—notably in the pages of a high class magazine this very month—of arrogance and dogmatism in matters which are outside its province. On the other hand, art is in the habit of asserting that, whatever may be its motive, its end is always praiseworthy, and is one that mankind cannot dispense with, except at the cost of its best and noblest self. Science is not disposed to admit this much of culture, and even goes the length of founding colleges—notably one at Birmingham—from which all that has hitherto gone by that name is excluded. Culture, as a consequence, takes fright, predicting of the race brought up in such a school a narrow and ignoble future. This, stated within the limits at our disposal, is how the relations between science and culture stand. The mere statement of them may help us to see how they might be reconciled.

First, it may be confidently affirmed that true science has nothing to fear at the hands of culture. It is a maxim in politics that a good man is made better for having an equally good man as his opponent; and the scientist will not suffer but will rather gain, through having his true province and mission constantly kept in view by a mental faculty differing from his own. Of course it would be begging the whole question to assert that imagination has the sole right to dictate what science shall do. But it will be admitted that, ruled by science alone, man would be a poor and in-

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complete creature. Science, therefore, cannot afford to be on bad terms with art. Neither, on the other hand, can art dispense with science; but it is notorious that it can and does afford to hold science—physical science—in somewhat light esteem. Carlyle once wrote of scientists that without reverence they were like a pair of spectacles behind which there were no eyes. The implication here is that science is deficient in reverence. We are not addressing the followers of Carlyle, else we might have something to retort upon this. For our readers the thing to be noted is that men like Carlyle can speak thus without losing caste in the eyes of the world, nay, indeed, are, perhaps, admired the more for having so spoken. When we reflect how much wider and deeper is the influence of the poet than that of the physicist over the minds of average humankind, we may well hesitate before needlessly provoking a collision.

It is true that provocation oftenest comes from the other side, but not by any means to science alone; and we may find consolation in the fact that politics, morals, and even divinity come in for their share of hard blows. It is worth remarking, too, that the hostility is often more apparent than real; at all events, it is not of a radical kind in the men whose names we have mentioned. One of them had an ambition to become an Astronomer Royal, and another has followed more than one branch of science with much aptitude and zeal. The spirit in which science is pursued, the aims it sets before itself, the claims it puts forward, are the points chiefly quarrelled with; and unless science is superior to criticism, and its followers above all reproach, these surely are legitimate subjects for discussion. Except in its calling into play very dissimilar and somewhat opposing faculties, there is nothing in culture essentially antagonistic to science, any more than there is in science towards culture. But whereas the one is sustained by love, whilst the other is borne only by reason, it needs no prophet to tell us which of them has the hardest career. For this reason, if for no other, we recommend a conciliatory attitude towards those powers which we have broadly classified under the word culture. Their want of sympathy is much to be regretted, but their want of patience or of tolerance would be a far more serious matter.

JOEL'S IMPROVED INCANDESCENT ELECTRIC LIGHT LAMP.

The light is produced by the heating to incandescence of the end of a thin carbon rod or pencil, which forms one electrode, and which is continuously fed through special and simple contact jaws against a fixed cylinder of copper forming the other electrode. The length of carbon between the jaws and the copper cylinder is about three-quarters of an inch, and from this the light emanates, chiefly, however, at that part near the fixed electrode where it becomes pointed by the action of the current, and therefore more intensely heated. In addition to the light produced by the incandescence of the carbon, there is also the glow or flame from the sides of the burning carbon to the copper electrode similar to the flame of an arc lamp, the light thus taking an intermediate position between the purely incandescent light of Edison and the arc lamp of Serrin, &c. A peculiar feature in the light is that the incandescent point of carbon becomes slightly curled in shape, somewhat like a mushroom where it wastes away and is replaced by the gradual forward motion of the pencil. The fixed electrode remains intact, and lasts for any required time. The carbon consumes from 2½ to 3 inches per hour for lights of 100 candle-power and upwards. The pencils used are of 5 mm. diameter, and in lengths of ¾ metres. In a table of the results of different methods of incandescent lighting given by Professor Adams at the last of his lectures on electric lighting delivered at the Society of Arts, it was shown that 715 candle-power per horse-power is obtained with this light.

The improvements in this lamp consist chiefly in the simplification of the mechanism in connection with the contact jaws, by which means the lateral pressure of the jaws and the feeding of the carbon pencil are attained by the action of one weight, as shown in the diagram (Fig. 4), the lateral pressure being thus always proportional to the downward pressure. Also in the details for rendering the lamps in the same circuit independent of each other, and its general adaptability for the purposes of interior and domestic lighting. On referring to the sectional view of the lamp (Fig. 2), E is the fixed copper electrode with the point of the carbon pencil *e* pressing upon it. The contact jaws are shown at J. The weight W, which actuates the lamp, is suspended by the continuous cords to the top of the lamp B, the cords then passing down through the weight and under one of the rollers

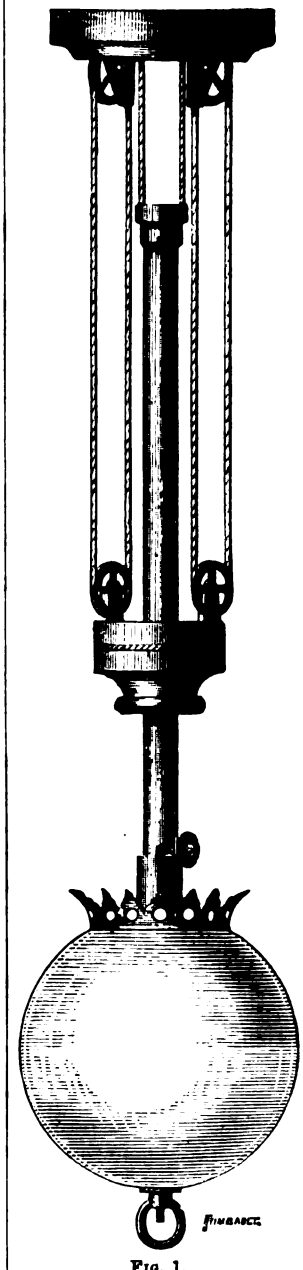

Fig. 1.

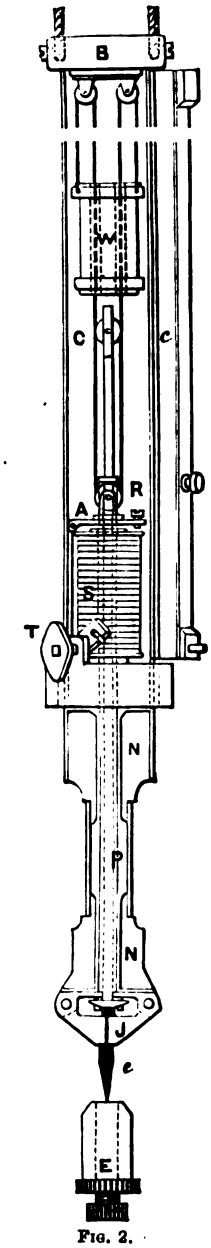

Fig. 2.

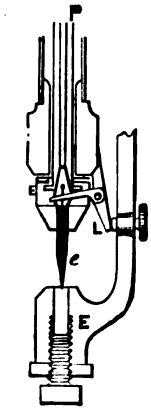

Fig. 3.

Fig. 4.

R, up again through a roller attached to the carbon pencil holder, then back through another roller at R, and ending at the weight. The rollers R are attached to a light tube P, which passes down through a nipple N, and terminates in a flange under the arms of the jaws, thus producing the lateral pressure on the carbon. The top of this tube has also attached to it the armature A of an electro-magnet S, wound with fine wire, and so arranged that if an arc should form between the carbon *e* and the copper electrode E, the electro-magnet S would come into action and free the jaws J from lateral pressure. The carbon holder is also arranged (Fig. 3) so that when the pencil is nearly consumed the lamp is short circuited by the lever at L making contact with the arm carrying the copper electrode.

The stem of the lamp C, *c*, is formed of metal tubing, cut in

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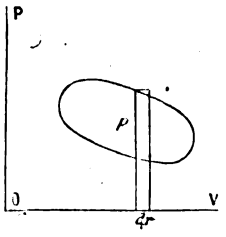
half and hinged, each half forming part of the electrical circuit. When the lamp is opened for the purpose of inserting fresh carbon, it is automatically short circuited in the act of opening by the button T (Fig. 2), so that it is rendered perfectly safe in handling by the most inexperienced. Fig. 1 shows one form of complete lamp, fitted with chandelier suspensions, similar to gas lamps, and which can be fixed by ordinary gas fitters. This suspension allows for raising or lowering the lamp, when putting in new carbons, cleaning globes, &c.

THE CONVERSION OF HEAT INTO WORK AND ELECTRICITY.*

BY M. MAURICE LEBLANC.

The method of conversion which we employ is to cause a body to pass through a series of conditions, and then to restore it to its original condition. In a word, to cause it to traverse a closed circular path (Fig. 1).



If by dQ we represent the elementary quantity of energy expended by a body at the moment when it is at the temperature T (the sign of dQ representing the direction in which it is expended), we have :—

$$\int p\,dv = \Sigma\,dQ$$

$$\int \frac{dQ}{T} \leq 0,$$

according to the two principles of thermo-dynamics.

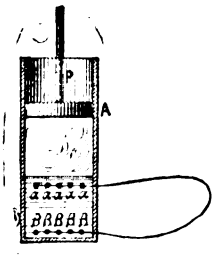
What follows depends upon the fact that these two conditions are independent of the way in which the energy dQ is expended. This is easily seen, if we remember that the principle of the conservation of energy leads us to admit two invariable proportions between the volume, temperature, pressure, and internal energy of a body or system of bodies, these two proportions being characteristic of the body or system.

We will endeavour to cause a body to describe a closed circular path, and when it has absorbed energy we will supply this to it again in the shape of heat; when it has given this off, we will make the energy appear in the shape of electricity by introducing it into a circuit such that the contact E.M.F.'s which it calls into existence are $\gtrless 0$.

The area of the path traversed will represent the work obtained, which may be *nil*, or the path may be reduced to a point.

We will give some illustrations in which this method of conversion is shown, and from which we draw some important conclusions.

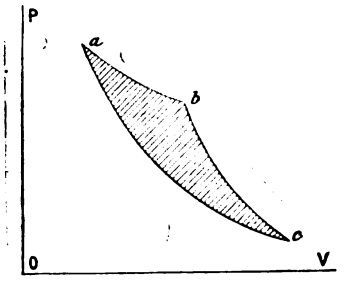
1st Illustration. Take a solution of zinc chloride saturated with ammonia; place it in a cylinder A (Fig. 2), in which is a



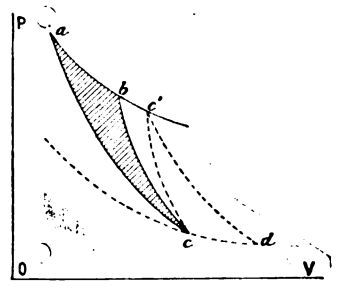
movable piston P; the liquid settles at the bottom of the cylinder, and the ammonia floats on its surface. Place a series of electrodes a, a, a, at the surface of the liquid, and another series at the bottom; close the circuit and lower the piston. The ammonia in condensing, will give rise to new conditions, which being less dense than the previous ones, will surround the electrodes a, a, a, and we shall have a true gravity battery. To avoid polarisation, the electrodes a, a, a, and b, b, b, should be of zinc, in which case we have the following series of contacts :—

$$(\mathrm{Zn}, \mathrm{Az}\begin{cases}\mathrm{H}\\ \mathrm{H\ Cl}\\ \mathrm{H}\\ \mathrm{Zn}\end{cases}) + (\mathrm{Az}\begin{cases}\mathrm{H}\\ \mathrm{H\ Cl, Zn\ Cl}\\ \mathrm{H}\\ \mathrm{Zn}\end{cases}) + (\mathrm{Zn\ Cl, Zn}) = \mathrm{E}.$$

The electrodes a, a, a, will be attacked, and a deposition of zinc on the electrodes b, b, b, will take place. It is easy to see how we may utilize this production of electricity, under these conditions in the solution of the problem we have set ourselves. Take this mixture of zinc chloride, and ammonia, and suppose that this gas has been compressed, once for all, to the surface of the liquid, so that it has a very strong tendency to dissociation at a low temperature, 0 deg. for instance. Allow this mixture to expand first at a constant temperature, then adiabatically, in a cylinder. Let $a\,b$ and $b\,c$ (Fig. 3) be the two parts of the iso-



thermic and adiabatic lines described by the body. Suppose that the cylinder is furnished with electrodes analogous to $a\ a\ a$ and $b\ b\ b$ mentioned above. Now, close the circuit and compress the mixture, without giving to or withdrawing from it any energy more than occurs through closing the circuit, to a point when the line $c\,a$, representing the new series of successive conditions through which the body passes, meets the isothermic line $a\,b$. Electricity will be produced. The line $c\,a$ will necessarily be below $c\,b$. For, supposing it to be above it, we should have the isotherm which passes by the point a to a point c' (Fig. 4), situate to the right of



b, and it would be possible to describe a cycle similar to $c\ c'\ d$, where work would be produced, heat would be given off along the isotherm $d\,c$ and electricity along $c\,c'$, and nothing would be expended (c', d being an adiabatic and of the same kind as $b\,c$), which is absurd. Similarly $c\,c'$ must not be confounded with $c\,b$. This line should, therefore, be found below $c\,b$, and be similar to $c\,a$.

Heat will be absorbed along $a\,b$, a certain amount of work represented by the area $a\,b\,c$ will be developed, and electricity will be produced along $c\,a$. We must not forget that we have supposed the upper isotherm to correspond to 0 deg. of temperature, and that the heat which is transformed will be of this temperature.

Remarks.—That this illustration may be strictly correct, it is necessary that we should be able to consider the body as homogeneous in all its parts each moment that it traverses the cycle; or, at all events, that, should it be left to itself at any moment, the pressure of the gas should vary only by an infinitely small quantity. In fact, if this be not the case, the coefficient of the angle of the tangent at $c\,c'$, at the point c, may be greater than that of the tangent at $c\,b$ at the same point; for if there be a spontaneous decrease of pressure under a constant volume at the point c' it will be necessary to absorb heat to return to this point, and there will no longer be anything absurd in describing the cycle $c\,c'\,d$.

This brings us to the supposition that each time we cause the

* Translated from *La Lumière Electrique*.

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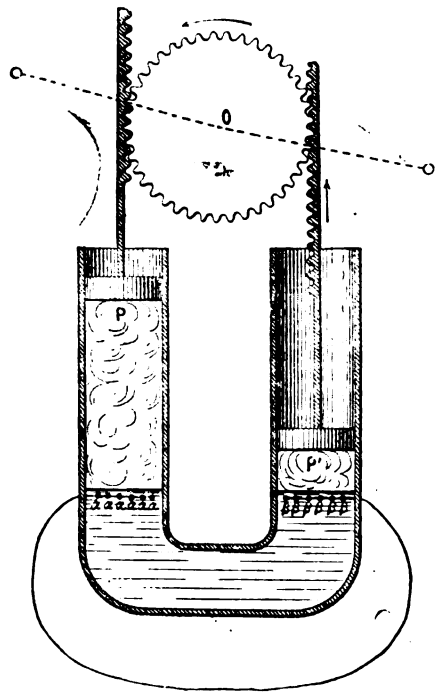
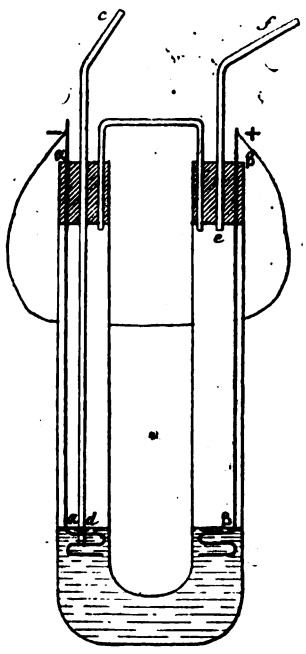
body to undergo an elementary diminution of volume, $d\,v$, we allow a definite period to arrive in which it tends to come back to itself by giving off the largest possible quantity of energy.

Let us suppose the upper electrodes a, a, a, to be very small. The elementary variation of volume which we cause the mixture to undergo will result at once in the modification of the composition of the surface of the liquid and of the portion which contains the electrodes. Little by little the ammonia will be diffused, and the E.M.F. diminished. But the action is finished almost as soon as it has begun, for the infinitely small quantity of gas which was compressed is in what we will suppose to be an equally infinitely small quantity of liquid. The composition of this portion of the liquid is thus varied in a finite manner.

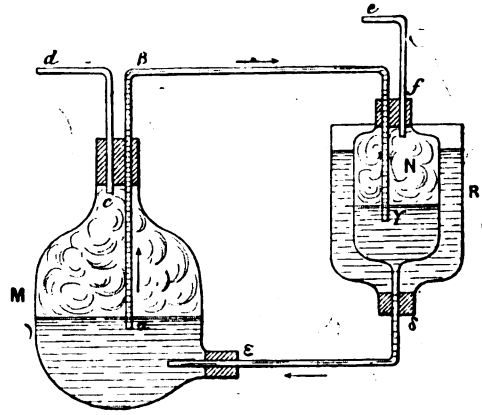
In lieu of the preceding cycle, we may make an instrument which converts its internal heat directly into electricity, without necessitating any expenditure of work, the usual form of which of which instrument is shown in Fig. 5.



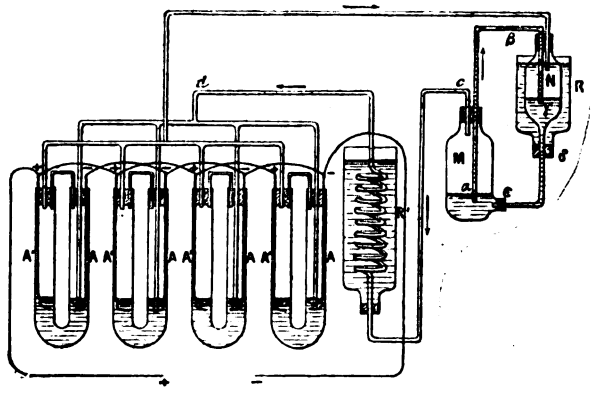
For practical purposes, the arrangement given in Fig. 6 is, to my mind, more convenient. Thus, instead of employing a



pump to determine the ebb and flow, on the advice of M. Napoli, I cause $e\,f$ to be in communication with a dilute solution of ammonia kept at a low temperature, and $c\,d$ with another warm ammoniacal solution, these two solutions being in connection by means of a thermo-syphon. This is what takes place—the warm ammoniacal solution in a flask, M (Fig. 7), loses its



ammonia, which escapes by the tube $c\,d$ and passes into A. But the warm liquid rises, by reason of its smaller density, in a syphon, $a\,\beta\,\gamma$ when set in action, and passes into N, which is kept cool by a refrigerator, R. Owing to its being cooled, this liquid becomes capable of absorbing the gas induced by $e\,f$. It finally returns to M by a tube, δ, ϵ. We have in this way a constant circulation from the one receiver to the other, the ammonia being constantly absorbed by $e\,f$, whilst it is constantly carried back by $c\,d$. This was the origin of the apparatus designed by M. Napoli and myself, and shown in Fig. 8.



We caused $c\,d$ to pass through a refrigerator kept constantly cool, as R, by a current of water, so as to avoid all transport of heat in the tubes A, A'.

The theory was thus verified. The electrodes a, a, a, were attacked, whilst electrolysed zinc was deposited on the electrodes $\beta\,\beta\,\beta$. (The solution which filled the tubes had been previously completely saturated by the ammonia.) The intensity of the current produced was very well defined on the galvanometer, in spite of the enormous resistance of the cells thus arranged. As to the E.M.F., we had no thought of ascertaining it, for it is sufficiently clear, after what we have said above, that we only required to demonstrate the existence of a current.

We would remark that the energy represented by this current can only proceed from the heat expended in warming the thermo-syphon, and a certain quantity of which can be considered as capable of being converted into work, owing to the difference of temperature set up between the two receivers M and N. In fact, suppose T to be the temperature of M, and T° that of N, as well as that of the refrigerator used to cool $c\,d$. We may imagine an infinity of sources at temperatures

$$T°, T° + d\,T, T° + 2\,d\,T, \ldots T° + n\,d\,T, \ldots . T$$

and supposing, that in order to cool the liquid of the thermo-syphon, as well as the gas which it gives off, we connect them successively with different sources, at the same time using only infinitely small differences of temperature. In the same way we could again heat by the same means the liquid which is charged with ammonia in N. The phenomena we have described would in no way be altered. But it is evident on the face of it that the quantity of heat necessary to keep the thermo-syphon going will be *nil*. Now let us consider two sources very close together. In

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the first case, we give over to the lesser source a quantity of heat:—

$$d\,Q = \phi\,(T)\,d\,T,$$

in the second we lend to the greater source:

$$d\,Q = \psi\,(T)\,d\,T,$$

and the part of $d\,Q$ capable of conversion into work is $\phi\,(T)\,\frac{d\,T^2}{T}$, that is to say infinitely small of the second order; it will be the same with the quantity of work necessary to raise $d\,Q'$ from $d\,T$.

(TO BE CONTINUED.)

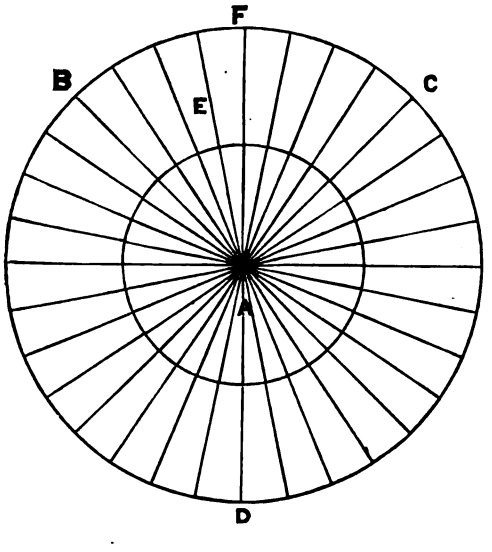
THE EVOLUTION OF DYNAMO AND MAGNETO ELECTRIC MACHINES.—II.

By γ. β.

(CONTINUED FROM PAGE 242.)

Before the construction of a machine is attempted, some study ought to be given to the principle upon which the action of the machine is founded. Romagnesi in 1802, and more particularly Faraday in 1831, made public the principle upon which magneto electric machines are based. The former discovered the action of an electric current upon a magnet, the latter discovered the converse action of a magnet upon a conductor. Faraday's conception of "lines of force" enables us to discuss with a considerable amount of confidence actions that would otherwise be difficult to understand. If any reader desires to know the opinions of mathematicians on this conception of Faraday's, let him consult "Papers on Electrostatics and Magnetism," by Sir W. Thomson; "Electricity and Magnetism," by the late Professor Clerk Maxwell, and similar books. We may, however, without going outside the aim of this article, make one or two quotations. Clerk Maxwell, vol. i., p. 147, says:—"Now, the quantity of electricity in a body is measured, according to Faraday's ideas, by the number of lines of force, or rather of induction, which proceed from it. These lines of force must all terminate somewhere, either on bodies in the neighbourhood, or on the walls and roof of the room, or on the earth, or on the heavenly bodies, and wherever they terminate there is a quantity of electricity exactly equal and opposite to that on the part of the body from which they proceeded." On the next page, he says, "The lines of force due to a single centre of force are straight lines radiating from that centre." Sir W. Thomson defines a line of force thus, "A 'line of force' is a line drawn through a magnetic field in the direction of the force at each point through which it passes, or a line touched at each point of itself by the direction of the magnetic force."

Now let us consider for a short time the second quotation from Clerk Maxwell. Let us suppose A to be a single centre of force, and the lines of force to be represented by straight lines, B C D,



&c., drawn in every direction from it. As the lines radiate equally in every direction, there will be the same number in any given area at equal distances from the point. For example, suppose a circle E, with centre A, the number of lines reaching each quadrant of E is equal; the same is true of a circle F, with radius longer than that of E, but the number of lines cutting any given length, say ·05in. of E is not the same as those cutting ·05in. of F or any other circle nearer or farther off the centre than E. Instead of imagining these circles, let us imagine such a centre of force and such lines of force, and that a wire with diameter ·05in. is brought into this field of force. Then when the wire is placed at the distance E from A, a number of lines of force will terminate at that wire, according to the first quotation from Clerk Maxwell. Suppose further, that each line of force has equal influence on whatever terminates it, then evidently the total influence of the lines of force on such a wire is equal to the product of the number, say n lines of force terminated, and the influence, say x, of each line of force $= n\,x$. Now move the wire from E to F, and we get an alteration of influence due to the fact that F being further from the centre than E, a less number of lines of force terminate in the wire, and therefore the product $n'x < n\,x$. If, however, the wire be moved nearer the centre A, then $n''x > n\,x$. The influence in the wire at any point equidistant from A is unaltered; and therefore if the wire was moved through the whole equidistant space, no change could be observed in it. Reference to books will show that the surface so described is, as is well known, an equipotential surface. So long as the wire has terminating in it the same number of lines of force, so long the influence is unaltered; but change the number so terminating, either to increase or diminish, and we get a corresponding change of influence.

We have previously said that Faraday discovered that a magnet induced a current in a wire brought near it. Suppose the point A to represent the pole of a magnet, and the lines radiating from it to represent the lines of force radiating from A, then the influence of A upon a wire brought into the field is such as we have described, and depends entirely upon the number of lines of force terminating in that wire. Further, we may suppose the so-called positive and negative currents of electricity to be the currents indicating the influence exerted by an increase or a diminution respectively of the number of lines of force terminating in the wire. The case we are discussing is hypothetical, but nevertheless we trust it will help in fixing certain ideas which we think all those who trouble themselves about electrical machines should possess. From the reasoning we have followed it will be seen that the greatest influence upon a wire would be when all the lines of force of the field terminated in it, and the greatest change would be from this condition to the one when no line of force terminated in it. In the one case, according to our assumption, we should have the maximum positive current, in the other the maximum negative current.

Indulging in a little transcendentalism, we may easily indicate how the maximum effects would be obtained with a given field of force. In the first place all the lines of force must be concentrated into one line, the influence of this one line equalling the influence of all the lines—*i.e.*, there must be no diminution of force in the concentration. We remember from our schoolboy days that a line is length without breadth. Then, secondly, the wire in which this line of force is to terminate must also be diminished to a line, so that it at once passes from the maximum state on the one side to the maximum on the other; and, further, if we could have a ring of such wires, so that the passage was continuous across a series of such lines of force, we should manage to obtain something very near perfection. It is well known that, by an arrangement of magnets, it is possible to deflect, and to a certain extent concentrate, the lines of force; but there is evidently a point past which such concentration will not be economical. We may also point out that to magnetise and demagnetise a core, to induce a current in a wire and to return that wire to its normal condition, takes time; and so it devolves upon the constructors of this class of machines to consider a somewhat complicated problem. That it will long remain impossible to specify the construction of a machine required to produce certain results under certain conditions we deny; but hitherto no such specification has been written. Are electricians agreed that the generation of a current of electricity in a wire is due to the termination in that wire of a certain number of the lines of force of the magnetic field? If so, it is certain that the greater the number of such lines of force cut by the wire and so terminating in the wire in a given time, the greater the current obtained in the time. Our object, then, should be so to arrange the machine that the lines of force cut by the wire shall be a maximum, and that these lines shall be cut in the least time. The next object is to return the wire to its normal condition as soon after the greatest effect is obtained as possible, and so in the wire produce these conditions without loss of time. As yet, so far as we know, no investigation has informed us how many times a current in a wire may be economically induced in a given period. If, again, we cannot know the absolute we may, at any

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rate, have an idea as to the comparative number of lines of force in any portion of the field of any magnet.

[The above appeared in the last number of the *Engineer*, our contributor thinking that its publication in both papers would tend to widen the discussion he hopes to raise upon the question. We shall be glad to have the opinions of those engaged in constructing machines upon the questions raised in this paper What, for example, have M. Breguet, Mr. Crompton, Mr. FitzGerald, Mr. Gordon, Mr. Ladd, Professor Perry, Dr. Siemens, Mr. Sprague, and Mr. Wilde to say on the subject?—ED. *E.*]

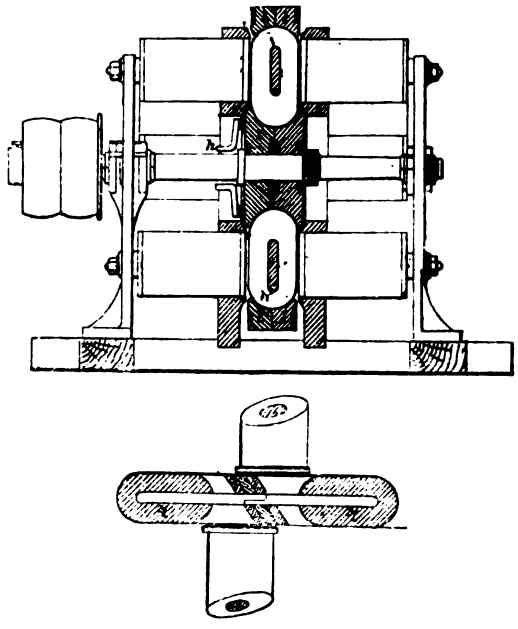
THE FUTURE DEVELOPMENT OF ELECTRICAL APPLIANCES.*

BY PROFESSOR JOHN PERRY, B.E., ASSOC. M.I.C.E.

(CONTINUED FROM PAGE 280.)

The result, then, to which the above laws led Professor Ayrton and myself was that for the future development of the transmission and distribution of electric energy it will be necessary to use electric machines of great electromotive force. Indeed, so important must this principle become, that we believe there is a future in this direction for the employment of plate electrical machines, such as that of Holtz. Now, the electromotive force of an electric machine may be increased in three ways:—1. By increased speed, as you see when I turn this magneto machine more rapidly (experiment shown). 2. By increased strength of magnetic fields. 3. By increasing the length of wire on the moving armature. Of these methods the first is most important. Now, if iron is used in the armature, since it is magnetised and demagnetised very rapidly, its coercitive force prevents this magnetisation and demagnetisation being as complete at the high speeds I contemplated as at the ordinary speeds of the present day. I say this in spite of the fact shown by some unpublished experiments of Professor Ayrton and myself, which imply that the magnetisation and demagnetisation of a bundle of fine soft iron wires are as complete when effected sixty times per second as when effected once per second. Besides this a very considerable quantity of heat is developed in such rapid magnetisation and demagnetisation as does occur. The electric machines of the future will, I am convinced, be without iron in their moveable parts. High speeds necessitate careful construction and the balancing of moving parts, and great attention being given to rubbing surfaces. By rubbing surfaces, I do not merely mean the bearings of the machine, but the commutator, which is rubbed by the collecting brushes. Much of the waste of energy by mere mechanical friction, which occurs in electric machines, occurs at the brushes; but, hitherto, other waste has been so great that this might be neglected as unimportant. But it is very important in the machines of the future. The loss of energy by friction is proportional to the number of revolutions per minute, and to the diameter of the rubbing surface. I have given considerable

PERRY'S DYNAMO MACHINE.



thought to the reduction of this friction, and have arrived at a form of commutator, shown in the diagram, which largely diminishes the loss. The parts of the commutator must be firmly fixed, but they must also be well insulated from one another, therefore they must be separated by some rigid insulator, such as ebonite, at the places where they are screwed up; hence they are necessarily far apart at these places. If they are rubbed at these places, however, there will be a great loss of power in friction, and hence they ought to be bent in towards the axis of rotation, where they may be insulated from one another by narrow air spaces, and where they may be rubbed by the brushes, with only a small waste of energy. This plan I have proved to be quite feasible. In the larger machines of the future its importance will become much more manifest than it can be in existing machines. This frictional principle is illustrated by the model before you. Here are two surfaces, making the same number of revolutions per minute. If the same amount of rubbing occurs you observe that when I rub the surface of larger diameter there is great loss of energy, and the motion is stopped; whereas, when I rub the surface of smaller diameter there is only a small loss of energy, and the motion is not stopped. (Experiment shown.)

This necessity for a great velocity of moving coils past fixed magnets necessitates increase of size of the armature, because for a given velocity the centrifugal force tending to burst the revolving armature is inversely proportional to the radius. For instance, here are two light wheels, made in exactly the same way. You can examine their construction after the lecture. They are rotated at a different number of revolutions per minute, so that the actual velocities of their rims shall be the same. You observe that the rim of the smaller bursts in pieces, and the larger is unhurt. (Experiment shown.)

There is another important reason for increased size, namely, that of similar dynamo machines, one twice as large as the other; the larger is capable of giving out eight or more times as much energy for the same number of revolutions per minute. It would delay me too much to go into this question of size fully; but if it be remembered that the electromotive force of each moving coil is proportional to its area, then, without taking into account increase of strength of magnetic field, which certainly occurs with larger machines, we get eight times as much effect for double the size. Electric machines of the future will then, probably, be of great size, moving with exceedingly great velocity.

The third method of increasing the electromotive force by having greater lengths of wire in the armature is always available; but, inasmuch as every increase so produced causes a proportional increase in the resistance of the circuit, and, therefore, a waste by heating, this method is not quite so economical as the increase of speed method.

It is to be remembered that the lifting power produced in an electro-magnet of given size is simply proportional to the heat produced in the wire on the magnet, and if it is our object to diminish this heat, we must discard all idea of working the magnets of electric machines by their own currents. In fact, the force of dynamo-machines, like these I have been using, will, in the future, be to feed the magnets of larger machines, or else they will give place altogether to magneto-electric machines.

I have now given you briefly some of the reasons which have occurred to Professor Ayrton and myself for believing that very large continuous current machines, with separate exciters, or, perhaps, even magneto-electric machines, driven very fast by steam engines, will have an important place in the future transmission of energy by electrical methods. With such machines it would be possible to heat, light, and ventilate all the houses in New York, and to give to large and small workshops the power required to drive their machinery by means of an ordinary telegraph wire (but with some exceptionally good method of insulation), transmitting energy from as great a distance as the Falls of Niagara.

When I speak of what will be done in the future in this direction, I can speak with perfect certainty. It is useless to tell us that existing machines are not economical. As I have already said, existing machines have been made for a very definite purpose—to show that much electrical energy and striking light effects may be produced by a small and portable machine. They have drawn the attention of capitalists to electric lighting and electric railways, and in this way have done great service. Calculations of possible economy in the future, deduced from their action merely, must be quite misleading. But if the facts given in this wall-sheet are correct—and, fortunately, there can be no doubt of their correctness—the practical transmission of all kinds of power to all distances, the supply of large and small quantities of light and machine power to all parts of a city like London from a single centre, and a consequent return to that old state in which in many trades it was possible to dispense with the congregation of great numbers of men in large manufactories, is a thing to be looked forward to with perfect certainty. I need hardly tell you that heating houses by elec-

* Paper read before the Applied Chemistry and Physics Section of the Society of Arts on March 24th, 1881.

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tricity will completely get rid of the smoke nuisance. I have been dealing with general principles, and electricians will take various plans to carry out the idea put before you. In my own machine I have carried them out in my own way. This is the largest machine which I could induce my kind friends, the firm of Messrs. Clark and Muirhead, to construct for me. I would, were money enough available, apply the principle to coils wound obliquely on the thin rim of a great fly-wheel of a large steam-engine, fixing magnets obliquely to one another on both sides of the rim.

I have so much pecuniary interest in the future of this machine that it would take from the impersonal character of the lecture if I brought it before you too prominently. Its performance may be examined into at the manufactory. If time allowed I would rather dwell on the enormous social phenomena which are preparing to develop themselves. England is a very rich country. She can afford, even through her Government, which dispenses only a small portion of her wealth, to carry out great enterprises at the ends of the earth. By her canals and roads and then by her railways she has made herself comfortable and has added to her wealth. Adding to her wealth is an accidental effect, perhaps, but adding to the happiness and health of the poorest people in this cradle of the Anglo-Saxon race is certainly the most important work to be effected by the wealth of England. To do this through the agency of electricity will not prove a bad financial investment.

Leaving this very large subject, let me speak of a few of the applications of the above principles which have a future before them. The development of the telephone and of telephone exchanges, until every person in London can speak directly with every other Londoner, and, indeed, with every other person in the country—this, as you all know, is quite a settled matter, although, no doubt, there are little difficulties still to be surmounted. At one end of a telephone wire there is a generator, a magneto-electro machine, which receives sound energy, and gives out electricity. At the other end there is a receiver or motor, another such machine, which receives electric energy and gives out sound. We have, in fact, a simple example, and one of the most economical examples I know of, for the transmission of power by means of electricity. Quick speeds caused by vibrations of many hundred times per second, and strong magnetic fields, have produced this wonderful economy, which enables men in Paris to speak with members of their families in Marseilles. Again, the subject of electric railways is a part of the much larger subject which I have already dealt with. I suppose you all know the general principle of electric railways as hitherto constructed. Only that we like to observe large effects produced, the model which is now working before you would give as clear ideas of future constructions of this kind as the Berlin railway, or the one to be exhibited at Paris. [In this experiment a circular railway was worked from a magneto-electric machine driven by hand.] A generator of electricity is driven by a large stationary engine, somewhere in the neighbourhood of the railway. A motor on a carriage receives electric energy by the conducting rails, and converts this into mechanical work to drive the carriage. Even the small experiments of Dr. Siemens show that there can be no doubt that the introduction of electric railways everywhere is merely a question of capital, and the sacrifice of much existing plant. This kind of proof was very much needed by capitalists. But the electrician sees much further; he sees better insulation for the conductor, and application of the above principles to hundreds of miles of rail instead of a thousand yards; he sees, in fact, that the larger the experiment, the greater must be its success. He looks forward to the absence of a vitiated atmosphere in our underground railways. He sees that the weight of rails (for there will be no heavy locomotive in the future; each carriage will have its own driving and breaking machinery), and the cost of bridges, and wear and tear of permanent way, may become less than one-quarter of what they are at present; he sees, in fact, all the advantages that will arise, when, instead of making a heavy steam-engine travel backwards and forwards with carriages, the carriages alone travel, and the steam-engine is not near the railway at all. In that case, also, all the energy at present wasted in stopping a train will simply be given back to the generator.

I have mentioned electric lighting, and telephones, and railways, because I know that many of you must have expected to hear of them, but I mainly wish you to consider these appliances as examples simply of the transmission of power by electrical means. In the same way I might refer to a countless number of other appliances, giving you a mere catalogue of them; but, from the ordinary house-bell to the complicated arrangement by which my brother regulates the weirs on a river to prevent floods—from the time-regulating luxury of certain clockmakers to the quadruplex telegraphy of Muirhead and Winter, they are simply methods of transmitting energy by electricity, and, as such, their economical development depends on the recognition of the above principles. Take for example, the case of ordinary telegraphy. There can be no doubt that it is absurd to fill large houses with tens of thousands of voltaic cells to work telegraph lines. But it is not sufficient for the Post Office authorities to feel the annoyance, and merely try to replace batteries with such a machine as you see before you, a machine of but one ohm resistance, while every mile of telegraph wire may have twenty ohms resistance. I am sure that everybody belonging to the telegraph department will be satisfied with a change that gives them one dynamo-machine for all those thousands of sloppy voltaic cells; and there is no longer any excuse for further delay, since Mr. Schwendler has been perfectly successful in working long telegraph lines in India in this very manner.

(TO BE CONTINUED.)

TWO PROPOSITIONS IN ELECTRO-MAGNETISM.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Will you allow me to state the two following propositions (*a* and *b*) in your paper? Not that I consider them to be either novel or likely to be instructive. I put them forward merely with a view to ascertain whether they can be controverted—in which case I should be glad to learn, instead of attempting to teach, something about electro-magnetism. On another occasion, I may, with your permission, make a few further statements of more obvious interest in connection with the construction of dynamo-machines.

a. When a core of soft iron is surrounded with a helix of wire, conveying a voltaic current, no reversal of magnetic polarity can occur in this core (*i.e.*, at no point in it can similar poles be opposed) so long as the direction (*dextrorsum* or *sinistrorsum*) of the turns of wire in the helix, and that of the current traversing it, is the same from end to end. This applies whether the core be continuous or whether there be in it interruptions of continuity of any kind.

b. In magnetising a bar or ring of soft iron, we may, generally, produce as powerful a degree of magnetisation by the action of a helix or coil of wire conveying a current, which affects the bar or ring directly, as by the inductive action of an electro-magnet, the current through which affects the bar or ring indirectly.

I may mention that these two propositions *have been* contradicted.—Yours, &c., DESMOND G. FITZGERALD.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES APRIL 20.		BUSINESS DONE WEEK ENDING APRIL 20. Highest.	Lowest.
Anglo-American	57¼,	8	58¼	58
Do. Preferred	86¼,	7	87¼	86¼
Do. Deferred	30,	¼	30¼	30
Brazil Submarine	10¼,	¼	10¾	10¼
Cuba	9,	¼	9¼	9¼
Do. Preference	16¼,	17	—	—
Direct Spanish	3¼,	4¼	4¼	4¼
Do. Preference	13,	14	13¼	13¼
Direct United States Cable	11¼,	¾	11¼	11¼
Eastern Telegraph	9¾,	10	10	9 15-16
Do. 6 per Cent. Preference	12¾,	13	—	—
Do. 5 per Cent. Debentures, 1899	101,	103	104	104
Eastern Extension	10 13-16,	15-16	10¾	10¼
German Union	11,	¼	11¼	11
Globe Telegraph and Trust Company	6¼,	¼	6 11-16	6 9-16
Do. Preference	12¼,	¼	12¾	12¼
Great Northern	12¼,	¼	12½	12¼
Indo-European	28¼,	29¼	29¼	29¼
Mediterranean Extension	2¼,	¼	—	—
Do. Preference	9¼,	10¼	10¼	10¼
Reuter's	10¼,	11¼	—	—
Submarine	270,	290	—	—
West India and Panama	2,	¼	2 5-16	2 3-16
Do. 1st Preference	7,	¼	7	7
Western Brazilian	8¾,	¼	8¼	8¼
West. Union 7 per Cent. 1st Mortgage	124,	129	127	127
Do. 6 per Cent. Sterling Bonds	104,	108	106	106

TRAFFIC RECEIPTS FOR MARCH, 1881.

COMPANIES.	March, 1881.	March, 1880.	Increase.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	3,100 estd.	3,586	—	486
Direct Spanish Telegraph Company	1,492	—	—	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	51,206	43,374	7,832	—
Eastern Extension Telegraph Company	29,661	26,425	3,236	—
Great Northern Telegraph Company	18,520	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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ABSTRACTS OF SPECIFICATIONS.

3324. IMPROVEMENTS IN DYNAMO-ELECTRIC, MAGNETO-ELECTRIC, AND ELECTRO-DYNAMIC MACHINES, *by C. G. Gümpel. Dated 16th August*, 1880. *Price 2d.*

This invention relates to the construction of dynamo-electric and magneto-electric machines for producing electric currents, or of electro-dynamic machines for conversion of electricity into motive power, and consists chiefly in a special form of rotating armature and a special manner of winding upon it the insulated wire. In the well-known Paccinotti ring armature, as applied in the Gramme machine, a considerable portion of the wire occupying the interior of the ring is useless, and there is a difficulty in firmly securing the coiled ring to the rotating axis, whilst the coiling of the wire also presents considerable difficulty. In the cylinder armature, as used in the Siemens machine, the wire on the surface of the cylinder has a tendency to fly off, owing to the centrifugal force when the armature is rotating at great speed, and when the cylinder is large a great quantity of the wire which has to cross the ends becomes ineffective. In order to avoid these objections the inventor makes the rotating armature in the form of a hollow open ended shell of magnetic material, either in one solid piece or built up of sheet, wire, hoop, or other convenient form of iron, and of a shape approaching that of an ellipsoid, the middle of the armature being larger in diameter than the two ends. He notches the ends of the shell or divides them by projecting fins, which may be continued as ribs along the outer surface of the shell, thus forming a number of sections or divisions for the reception of the insulated wire, which he winds thereon in the following manner. In a Provisional Specification, dated 24th July, 1880, No. 3041, was described the arrangement of an even number exceeding two of short magnetic fields around a rotating armature. Assuming that there are four such fields, then he arranges the wire on the shell in a number of divisions or sections, which is a multiple of four by any odd number. If, for example, the odd number selected be five, so that the number of sections is 20, then the wire is wound in these sections in one of three ways, the first of which we give:—The wire is wound forwards along No. 1 division, backwards along No. 6, forwards again along No. 11, backwards along No. 16, and thence again to No. 1, leaving free both ends of the wire so wound. Another wire is wound in a similar manner along Nos. 3, 8, 13, and 18; a third wire similarly along Nos. 5, 10, 15, and 20; a fourth wire similarly along Nos. 7, 12, 17, and 2; and a fifth wire similarly along Nos. 9, 14, 19, and 4; thus filling all the 20 divisions by five wires presenting 10 free ends, which are connected to the plates of a commutator provided with brushes or collectors in the usual manner. When the number of polar fields is 6, 8, or any other even number, and when the number of divisions of the armature is a multiple of the number of fields by an odd number other than 5, the methods of winding and connecting the wire are similar to those of which examples are given above, the commutator having in each case a number of brushes or collectors suited to the number of separate currents to be collected.

238,557. SPEAKING TELEPHONE, *Francis Blake, Weston, Mass.—Filed January 19th*, 1881.

Claim.—In a battery telephone, a branch circuit of proper resistance forming a bridge for the

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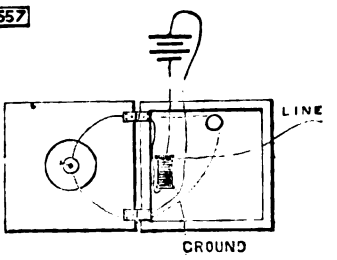
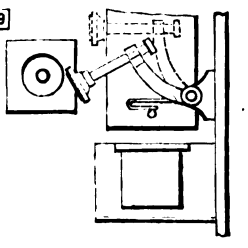


two electrodes, substantially as described.

238,689. TELEPHONIC APPARATUS, *Henry Howson, Philadelphia, Pa., assignor to John L. Kite, same place.—Filed January 18th*, 1881.

Claim.—In telephonic apparatus, the combination of a transmitter, a switch, a receiver, and a support for the same, with mechanism whereby the receiver may be held to the ear without the

238689

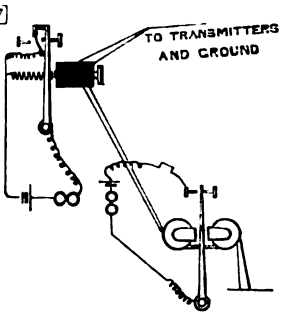


aid of the hands, and whereby the switch is automatically operated on adjusting and releasing the receiver, all substantially as described.

238,707. MULTIPLEX TELEGRAPH, *Henry C. Nicholson, Kenton, Ky.—Filed January 10th*, 1881.

Brief.—A device for riding over the kick in quadruplex telegraphs. When the neutral relay is demagnetised by a change of polarity its armature falls back, but not far enough to break the circuit of the local until the proper transmitter

238707



puts a weaker current to line regardless of polarity. *Claim.*—A neutral relay subject to reversals of the flow of the line current, the armature lever of which has a hook, forming one terminal of the local battery, and also carries an insulated contact spring, forming the other terminal of said local battery, substantially as before set forth.

238,715. SIGNALLING APPARATUS FOR TELEPHONE LINES, *John D. Richardson, Jr., Newport, R.I.—Filed November 10th*, 1880.

Brief.—A step-by-step movement consisting of sliding ratchets actuated by the bell armature. One ratchet controls a shunt circuit, which includes the station circuit closer and the armature, and the other ratchet controls a device for preventing the bell hammer from striking the bell except when required. *Claim.*—(1) The combination, substantially as hereinbefore set forth, of an electro-magnet and armature, a shunt circuit passing around said electro-magnet, a spring contact in said shunt circuit adapted to be opened and closed by the vibration of the armature, and an independent circuit closer in said shunt circuit, which is brought into action to close the shunt by means of a determinate number of pulsations traversing said electro-magnet. (2) The combination, substantially as hereinbefore set forth, of a call or alarm bell, an electro-magnet and its armature, whereby the same is actuated, a pawl, a series of ratchet teeth, a shunt passing around said electro-magnet, and a circuit closer, which is brought into action by the contact of the pawl with one particular tooth of the series of ratchet

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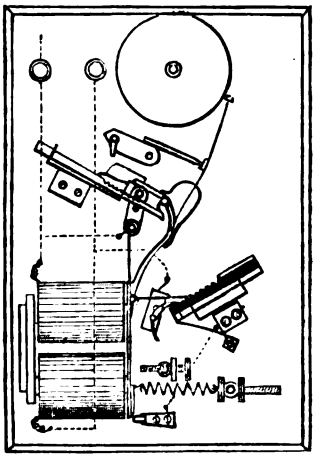

teeth. (3) The combination, substantially as hereinbefore set forth, of an electro-magnet and its armature, a pawl, a series of ratchet teeth, a dog or stop pawl, and a pin for tripping said dog at a determinate point in the movement of the ratchet. (4) The combination, substantially as hereinbefore set forth, of an electro-magnet and its armature, a pawl, a series of ratchet teeth, a dog or stop pawl, a pin for tripping said dog, and a spring for holding said dog out of the path of the teeth after having been tripped by said pin. (5) The combination, substantially as hereinbefore set forth, of a series of ratchet teeth, a dog, a spring for holding said dog out of the path of the ratchet teeth, and a pin moving with the ratchet teeth, which acts to trip the spring and engage the dog with the said teeth when the mechanism is restored to its normal or zero position. (6) The combination, substantially as hereinbefore set forth, of an electro-magnet and its armature, a bell hammer attached to said armature, and a bell with a stop lever, a lifter, a series of ratchet teeth, and a pawl actuated by the said armature.

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SLIP

CABLE REPAIRED.—The cable between Colon and Panama, which was interrupted eight months ago, is now repaired.

NEW COMPANY.—An electric light company has been established at Buffalo, U.S.A., with a capital of 100,000 dols.

ELECTRIC LIGHT IN THEATRES.—We hear that the new theatre in Panton-street is to be lighted up by the electric light.

TELEGRAPH LINE INTERRUPTED.—The lines between Blagowestchensk and Wladiwostock, in Asia, are said to be interrupted.

ANOTHER PAPER.—The *Operator* announces a new paper connected with telegraphy in the United States under the title of the *Boston Telegram.*

THE TELEPHONE IN MEXICO.—The Mexican Gulf Steamship Company has established a telephonic line between San Andres Tuxtla and San Tecomapam.

THE PARIS THEATRES AND FIRE.—An order has been issued, under which all theatres must be put in telegraphic communication with the fire stations.

AMPERE'S LETTERS.—The correspondence of Ampère, which was in the possession of M. Charles Levêque, has been given to the Library of the French Institute.

THE TELEPHONE IN ITALY.—We learn that the Minister of Public Works has consented to the erection of telephone lines in Rome, Naples, Milan, Genoa, and Turin.

ALGERIA.—A *Times* telegram of the 26th inst. says:—The telegraph was cut yesterday between Tunis and the Algerian frontier. News is now sent daily by boat from Tunis to La Calle.

THE SWAN AND CROMPTON LAMPS.—A successful experiment has been made at Norwich in having a Swan incandescent lamp in the same circuit with a Crompton arc lamp of 6,000 candle-power.

GREAT NORTHERN TELEGRAPH COMPANY.—The final dividend of 5s. per share for 1880 is now payable at the company's bankers, Messrs. C. J. Hambro and Son, 70, Old Broad-street, London, E.C.

A NEW AMERICAN CABLE (PENZANCE, APRIL 25.)—Arrangements are being made for the laying of a new independent telegraph cable, between a point near Land's End and America.—*Daily News.*

THE PARENTAGE OF THE TELEPHONE.—The little city of Brantford, Ontario, claims the honour of being the place where Professor Bell carried on his first experiments which led to the discovery of the telephone.

TELEGRAPH CLERKS' GRIEVANCES.—The *Daily Telegraph* has reason to believe that the Postmaster-General will ask the Treasury for its sanction to increased expenditure in his department, with a view to meet the claims of the telegraph clerks.

IS IT POSSIBLE?—The *Colonies and India* says that 800 sheep have been killed by a flash of lightning at Coolah. We can only suppose that they were all congregated under or near one tree, or grove of trees, otherwise this statement seems almost incredible.

THE FINSBURY TECHNICAL COLLEGE.—The laying the foundation stone of this institute, which was fixed for the 3rd of May, is postponed until the 10th of May, owing to Prince Leopold, who is to perform the ceremony, being unable to attend on the first-named date.

CAPE COAST CASTLE.—Recent advices from Africa say that Lieutenant Hart, V.C., R.E., was engaged in constructing a telegraph line from Cape Coast Castle to Elmina, this step being, no doubt, prompted by the recent threatened outbreak on the part of the Ashantees.

THE TELEPHONE IN CALCUTTA.—Calcutta expects to have its telephone system in operation by October next. The work of construction might have been got through earlier, but the Lieutenant-Governor insisted on having iron and not wooden posts for the wires.—*Homeward Mail.*

ELECTRICITY FOR DOMESTIC USE.—*La Lumière Electrique* says that M. Regnier is engaged at the laboratory of M. Phillipart in the Rue Bazen, Paris, in the solution of the problem of storing electricity, and utilising it for the production of light and motive force for domestic use.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—We regret that, in consequence of the President's announcement having been imperfectly heard, our last issue gave the date of the adjourned discussion on Mr. St. George Lane Fox's paper as 12th May instead of 28th April.

MORE ELECTRIC LIGHTS FOR PARIS.—*L'Electricité* says that M. Philippart has requested leave from the Municipal authorities to light the Place de la Concorde, the Place de l'Etoile, and the Avenue des Champs-Elysées, with the Regnier lamp during the time for which the exhibition will be open.

THE INTERNATIONAL EXHIBITION OF ELECTRICITY.—The city of Paris is about to vote a sum of 30,000 francs for the organisation of an exhibition of its own, which will comprise plans of the telegraph lines, &c., of the city, the apparatus in use, the means for protecting public buildings from lightning, &c.

TELEGRAPHIC COMMUNICATION WITH LEWS.—There is great regret amongst the Scotch fishermen that there is no prospect of the Lews telegraph cable being repaired before the commencement of the herring fishing season, as it is said that serious loss will be entailed upon all the parties engaged in the district.

THE ELECTRIC LIGHT AT THE CENTRAL TELEGARPH STATION.—The experiments with the Brockie lamp in this building are being persevered with, and seem to promise well. A 10 h.-p. engine, made by Marshall of Gainsboro', is employed to feed the five lamps, to which number the experiment is limited at present.

ELECTRIC LIGHT IN LONG BRANCH, U.S.A.—The Long Branch (N.J.) Commissioners have granted the Hussy Electric Company the privilege of laying a pipe through Ocean-avenue, and it is understood that the avenue will be lighted with electric lights next summer at a less cost than heretofore paid for gas.

INDIA RUBBER TUBING.—The Director of Navy Contracts invites tenders for india rubber tubing, &c. Forms of tender and all information may be had by writing to the Director of Navy Contracts, or by personal application at the Contract Department, Admiralty, Whitehall, S.W. Tenders by 2 o'clock on the 3rd May.

TENDERS FOR TELEGRAPH POLES.—The directors of the Great North of Scotland Railway invite tenders for the supply of about 1,700 larch or Norway red wood poles, to be delivered by July. Specification, &c., of the storekeeper,

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Waterloo Station, Aberdeen. Tenders to Mr. W. Moffatt, secretary, at the same station.

THE CITY AND GUILDS OF LONDON INSTITUTE.—We learn that the technical classes here have been attended by several females, and it is hoped that in the forthcoming session their number will be increased. Special arrangements for separate classes would, we are informed, be made forthwith if any considerable addition take place.

JAMAICA TELEGRAPHS.—The postal telegraph service in the island of Jamaica comprises thirty-two stations, and employs thirty-five female operators. There are about 470 miles of wire now in use, which completely encircle the island. The superintendent is Mr. H. C. Wilson, who was first employed with the old Electric and International Telegraph Company.

POSTAL TELEGRAPHS.—Mr. R. Price Williams's paper on "The Present Postal Telegraph Tariff" read before the Statistical Society in December last, is published in the *Statistical Journal* for March. Some excellent diagrams, showing the number of telegrams sent between 1855 and 1880 in Great Britain, the revenue and working expenses, &c., are given.

THUNDERSTORM IN LONDON.—On Tuesday, between one and two in the afternoon, a smart thunderstorm passed over the West Central and South Eastern districts of the metropolis. During the storm the western gable of the new Board School in Orange-street, Union-street, Southwark, was struck by lightning and hurled to the ground. Fortunately, no one was in the building at the time.

THE "DACIA" AND "HORNET."—A despatch from Vera Cruz, dated April 5, states that the cable steamer "Dacia" has completed the first section of the Central and South American cable southward. This cable was constructed by the Silvertown Company. The cable surveying steamer "Hornet" is at Acapulco, having taken very satisfactory soundings for the cable from Callao to Tehuantepec.

A GENEROUS OFFER.—M. Philippart has written a letter to the Ministre des Postes et Télégraphes in Paris, offering a sum of 100,000 francs to encourage the construction of better dynamo-electric machines. This sum is to be divided into three prizes, one of 40,000 francs for machines of over 10 h-p., a second of like amount for machines of 1 to 10 h-p., and a third of 20,000 francs for machines under 1 h-p.

PRICES.—The prices as quoted are:—For gutta percha, per lb., genuine 4d. to 3s. 3d., reboiled 3d. to 1s. 3d.; for india rubber, per lb., Para, fine, 3s. 6d., negrohead 2s. 5d., central American 1s. 11d. to 2s. 6d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d. Para, fine, is reported as firmer, but other kinds of business continue restricted.

FRESH GRIEVANCES IN THE POSTAL TELEGRAPH SERVICE.—The linemen who, says the *Daily Telegraph*, carry the wires all over the country (*sic*), have petitioned the Postmaster-General on account of the severity and hardships of their duty, which sometimes necessitates their exposure throughout the night in the stormiest weather, and the remuneration for which is at the rate of only three-halfpence per hour.

ACCIDENTS BY LIGHTNING.—A wonderful effect of lightning is reported from South Carolina, America, by the *Journal of the Telegraph*. It appears that as a Mr. Best was crossing a field on his farm during a thunderstorm on the 18th March last he was struck by a flash of lightning, which not only killed him but also tore up the ground on which he stood to such an extent as to bury him in a hole several feet deep—indeed it took some hard work with the spade to get to his dead body.

THE ELECTRIC LIGHT.—A city clerk—we do not know whether he is the identical one sung of so pathetically by Mr. Scott in the columns of *Punch*—sends us a cutting from an American paper *apropos* of our note of last week. Here it is:—"The electric light will burn and tan, and develop freckles like the summer sun. How popular (says the *Philadelphia News*) it will be with families who spend the summer season in the back rooms of their houses."

SCIENTIFIC THIEVES.—Some thieves recently broke open the Government Telegraph Office at Meean Meer (India). They took away two boxes, which contained nothing but papers, the treasure chest, which was buried in the ground, having escaped their fingers. The boxes which were taken were found on the morning after the occurrence about 100 yards from the office, completely ransacked, but nothing was missing except about two quires of carbon paper. We do not know, but we are afraid those thieves were disappointed.

NORWICH.—The Fisheries Exhibition is lighted by nine large Crompton lamps of 6,000 candles each, driven by Bürgin machines. There are also thirty Swan lamps, driven by a Gramme machine. It is proposed that at the close of the exhibition the Crompton apparatus shall be permanently fixed for lighting the Market-place and several of the public buildings. The effects of the light in the main hall of the exhibition are very good. The cases of stuffed fish, casts, &c., being all of bright colours, conduce to the result obtained.

TELEGRAPHS OF THE WORLD IN 1880.—It appears that at the close of last year there were in the United States 170,103 miles of line, and that during the year 33,155,991 messages were sent. The miles of wire were about 300,000. This does not include the lines used exclusively for railroad business. The other countries having the greatest length of lines are as follow:—Russia, 56,170 miles; Germany, 41,431; France, 36,970; Austria-Hungary, 30,403; Australia, 26,842; Great Britain, 23,156; British India, 18,209; Turkey, 17,085; and Italy, 15,864.

THE TELEPHONE IN CENTRAL ASIA.—Telephonic communication is said to have been successfully established between the Russian base of operations at Krasnovodsk and the first of the Akhal Tekke settlements at Kizil Arvat, 150 miles from the coast. The sounds are distinctly heard, even coughing and laughing at Kizil Arvat being faithfully conveyed to Krasnovodsk. General Skobeleff is reported to be much pleased with the success of the experiments, and proposes establishing telephonic communication between Krasnovodsk and Baku by means of the Caspian cable.

THE ELECTRIC RAILWAY AT PARIS.—Messrs. Siemens Brothers, with their weather eye on the future, have asked the Municipal Council of Paris to be so kind as to assign to them a place in that capital to which they may transfer their electric railway after the close of the Exhibition, their intention being to establish it permanently in whatever spot may be allotted to them. The Council have not, so far as we know, replied to this request, but we hope that they will grant it. The more practical testing the railway of the future undergoes during its infancy the more perfect will be its manhood.

THE CROMPTON LAMP.—In our last issue by error we mentioned the Brush light as used at Greenock. The lamp used is that of Mr. Crompton. As we have previously stated, Mr. Crompton has four of his ordinary lamps on the quay, each driven by a separate Gramme machine. The

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lights continue to give great satisfaction, and there has been no hitch since they were erected. We understand that owing to these lights being so satisfactory, the town council has given an order for an additional large light to be placed on the church, which will light up the principal square and part of three streets.

An Electric Fence.—Everyone has seen the electric shock stalls at a fair, and has perhaps seen the man in charge catch the flies which bother him (otherwise, little boys who play round his stall) by means of wires charged with electricity which run down the posts of his stall. A certain Mr. Connelly, of Pittsburg, has applied this system to a cattle fence, the electricity taking the place of the barbs in general use in iron fences, the object being to repel the cattle by a slight shock instead of pricking them as the barbs do. We are afraid this is an idea which will take some time to commend itself to farmers, English or American.

Electric Light in Cincinnati.—The method by which the Brush Electric Light Company proposes to illuminate the city of Cincinnati, if the Board of Public Works accepts the offer, is to erect towers 200 feet in height and place on top of them lamps with a capacity of from 16,000 to 18,000 candle-power, and on seventy-five foot posts lamps of from 2,000 to 4,000 candle-power. A central station has been established, five machines, with a total capacity of 208,000 candle-power, are now being manufactured, and the company expects to be ready to commence operations within a month from this date. According to the contract the cost is to be 25 per cent. less than the price now paid for gas.—*Engineering News*, New York.

The Telephone in Glasgow.—The National Telephone Company has been formed to amalgamate all the Exchanges in Glasgow, of which there are three, viz., the A. B. C. Telegraph Exchange, and the Bell and Edison Telephone Exchanges. The number of subscribers will be something like 500, excluding public institutions. There is already telephonic communication between Glasgow and Greenock, over a distance of twenty-two miles, by means of a private wire; a formal application has, however, been made to the Post Office in London to couple up the exchanges of the National Telephone Company between Glasgow and Greenock, so that members of either Exchange can talk to every member both on the Glasgow and Greenock Exchanges.

Electric Light at Messrs. Lewis's, Manchester.—We are informed that this firm have had the electric light at work in their Market-street premises for the last three years. They have thirty-three lamps in all, supplied by one alternate current machine with small exciter, the motor being a 10 horse-power horizontal engine. The lights are so arranged that one or all of the various departments can be lit up independently of each other. Any lamp in the circuit can be extinguished and re-lighted without interfering with the others; some of them are in use from eight to twelve hours per diem. One large 6,000 candle light is erected at a great height above the building, and can be seen for several miles round. Mr. Williams is the electrician in charge of the lights.

An Electric Tricycle.—M. Trouvé has made experiments with an English made tricycle, weighing about 55 kilogs. He fixed two of his electric motors, supplied with electricity by three secondary cells, such as he uses for his polyscopes, to each side of the machine, the motors being connected one to each crank. A friend rode the machine, which traversed the Rue de Valois, an asphalted street, at the speed of an ordinary cab. The experiment was continued for an hour. The total weight of the tricycle with M. Trouvé's friend on it was 160 kilogs., and the effective force produced by the two motors, seven kilogrammetres. M. Trouvé is at work on a motor, the effective force of which he puts at 10 kilogrammetres, and with which he hopes to attain a speed of from 20 to 30 kilometres an hour.

Lightships and the Telegraph.—Sheets numerously signed of the national petition in favour of telegraphic communication between the lightships around our coasts and the shore have been forwarded to Mr. Hobbs, of Ramsgate, by the Mayor of Gateshead and other gentlemen in various parts of the kingdom. In a pamphlet addressed by the philanthropic promoters of this reform to mayors, yacht and sailing clubs, and persons interested in mercantile pursuits, attention is directed to the loss of "Indian Chief" on the Long Sand, when only eleven lives were saved out of twenty-nine; to the recent wreck of the Dutch fishing smack on the same spot, when only one out of seven was saved; and to the total loss of the "Nymphœa" on the Sunk Sands, with all hands. These instances are considered to be striking proofs of the importance of this movement. In the second case the one sailor saved had been clinging to the mast for nearly four days.

Swan's Lamps in Newcastle.—The interest taken in the respective merits of electric *versus* gas lighting in this town during the past fortnight will be much increased by further experiments just made by Mr. Joseph Swan. White conical reflectors have now been added to the lamps, and the wicks have been re-arranged so as to form a corona of light within the lamp, which, seen from a distance, looks exceedingly massive and pure. The perfect steadiness of light and beautiful silvery colour displayed on Thursday, the 22nd of April, under the new arrangement was seen to great advantage. The illuminating powers of the electric lamp indeed, compared most strikingly with the glow emitted by the largest type of Bray's latest pattern of burners, which have now been placed in the single lamps at the other side of the street, but which shed forth a ray wavering and somewhat brown in colour compared with that of the new innovation. The new lamps, in fact, seemed to us and to others to emit a light of at least nine times the power of the new gas burners, and they showed considerably better than the triple burner Bray lamps which have been placed at the two opposite corners, forming the junction of Grey, Dean, and Mosley-streets, and which for a time, a few nights ago, certainly outshone the electric lamps as they were then arranged.—*Newcastle Daily Chronicle.*

Tapping the Telegraph.—A similar experience to that recently communicated to us by Mr. Ash, of Porthcurnow, is reported from Switzerland. A certain M. J Coudray, telegraphist, of Montreux, in a pamphlet of his, says that:—"Two years ago, at the instance of the poprietor of the Hôtel des Alpes, at Territet-Chillon, he placed that establishment in telephone communication with a chalet on the hillside, about 500 metres above the hotel. The conducting wire was insulated in the usual way, and the circuit completed through the earth. When he applied his ear to the telephone M. Coudray often heard crepitations, similar to the sounds observed in telephones, the conducting wires of which run parallel and close to the wires of a telegraph. One morning in the month of May last, being at the Hôtel des Alpes, he put his ear to the telephone, and heard the sound of messages which were being sent through the post office wires on the railway, 100 metres distant, so clearly that he was able to distinguish the purport of two, one of which was being transmitted from Montreux to Geneva, the other from Ouchey to Monthey, in th Valais." M. Coudray concludes from this

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that the secresy of telegraphic messages, whenever there is a telephone in the neighbourhood of the wires, cannot be considered inviolable. In practice, however, the difficulty of distinguishing them will probably be a sufficient bar to impertinent curiosity.

Gas v. Electricity.—Mr. Sugg, the well-known inventor of gas burners, writes to *The Times* of the 21st April, in reply to a letter from Mr. F. Nettlefold on the subject of the electric light. Mr. Sugg ridicules the idea of electricity competing with gas for street lighting. Whatever electricity has done or may do, one thing is certain, and that is, that it has had a beneficial effect upon gas people generally; it has stirred Mr. Sugg himself up, and in consequence, some of our streets are not lighted by so many farthing dips, but by something really worth calling a light. We congratulate Mr. Sugg on his new lights. Moreover, electricity, or something else—we incline to electricity—has caused a great reduction in the price of gas all over the country; has roused up men to the invention of numerous gas stoves, to the great benefit of the public. It is hardly likely that the child can compete with the man, but let the electric light get a year or two over its head, let corporations and others continue to give it a practical trial, so that its faults and failings may be ascertained, and we do not for one moment doubt the result. Gas must as inevitably give way, as did the old oil lamp, at all events for lighting purposes. We are not "bears," and know nothing of Stock exchange matters. We merely state our firm belief, by which we are quite content to stand or fall. The electric light has many difficulties before it, so had gas in its earlier days. It overcame them, so will the electric light, and *quam cito*, too.

The Telephone in Chicago.—The telephone is extensively used in this enterprising city. Here is a short account of some of the uses it is put to by the civic authorities. At convenient points district stations are established, with relays of policemen and a horse and waggon always in attendance. The waggon carries a stretcher, blankets, &c., for receiving and properly treating sick or injured persons &c. In telephonic connection with these stations are public alarm stations, like sentry boxes, placed at suitable points along the streets. These boxes are just large enough to hold one man, who may lock himself in should privacy or special security be an object. Keys to these boxes are furnished to respectable citizens, and are carried by all policemen, who also carry a releasing key by which the general key can be withdrawn from the lock. This is to secure the attendance of the person giving the alarm, and prevent possible trifling with the system, each key being numbered and the holder's name registered. When an accident occurs the nearest citizen holding a key goes to the alarm box, depresses a lever which projects from the signal box, and so transmits a call for help to the district station. At once three men, with the patrol waggon, hasten to the spot. If the policeman of that beat is near he unlocks the inside signal box, and communicates with the district station by means of the telephone which hangs inside. The specific character of the alarm—whether fire, murder, riot, or what not—can be signalled mechanically by means of a pointer which is turned to the proper position on a dial on which these words are printed. The number of alarm stations at present in use is about 100, though it is expected that double that number will be at work before the end of the year. The system is said to work very efficiently in practice.

Gas Companies and the Electric Light.—At the meeting of the London Gas Light Company, to which we referred in our last, Mr. Rawlinson (one of the directors) said that the electric light certainly did act as a scare to those persons who were not cognisant of what was going on, and there were interested persons who wished to make it act as a scare for the purpose of depreciating gas shares, so that they might become possessed of them at a low price. There was another scare coming, of which, no doubt, such persons would take advantage, but which was not generally known. Power would be sought from Parliament to be given to corporations throughout England to allow any persons proposing to introduce electricity into the public streets and houses to break up streets and roads to lay the cables for electric light. So far from this being injurious to gas interests, he thought all these movements in electric lighting would result in absolute advantage, because it would put the manufacturers of gas upon their metal—it would compel those who manufactured gas to make it of the best possible quality, and it would also compel those who had the management of the gas works to see that the fittings used were of the best quality. A great deal of the disparagement of gas had arisen from carelessness in purification, and the carelessness of users in having bad fittings. It might result in this, that inspectors should go round, without waiting for complaints, and see that the fittings were of the best description. He was not so ignorant or so prejudiced as to believe that there would be no progress in the use of the electric light. He believed that it would accomplish considerably more than they had seen; but at the same time he did not think it would do anything to interfere seriously with the profits of the gas making, if the gas makers were true to their own interests.

Professor Helmholtz at Edinburgh.—On Monday week last Professor Helmholtz read a paper before the Royal Society of Edinburgh, of which he is an honorary fellow, on "Electrolytic Convection." Sir William Thomson occupied the chair. The learned Professor, who was received with applause, said that he had entered upon his experiments on account of certain objections that had been made to Faraday's electrolytic law, in connection with experiments which showed that a very feeble galvanic current could be kept up by moderate electromotive force between platinum plates dipped in a slightly acidulated solution, even if the electromotive force of the battery was not sufficient to decompose the water. He had found in his earlier experiments that the only effect of the current was to absorb oxygen given off from the atmosphere and to form a new portion of water, and that the whole electrolytic effect was not to decompose water and to produce a new quantity of elements—hydrogen and oxygen—but only that on the surface of one plate of platinum oxygen was collected and taken away from the surface of the other. He had, therefore, called these currents electrolytic convection. It was not really a decomposition, but only a transport of one of the products of electrolytic decomposition from one place to another. In his later experiments he had got rid of the atmospheric oxygen by enclosing the whole electrolytic fluid in a sealed glass vessel. As a result, he had found that the smallest electromotive force, down to the thousandth of a Daniel cell, produced a strong deflection which went immediately back to zero, that there was no continuous current, and that, if the current were broken, a deflection was obtained of the same character in the opposite direction to the first and direct one. Sir William Thomson said that Professor Helmholtz's theory of electrolytic convection formed quite an era in electrolytic chemistry. He also communicated a paper "On the Average Pressure Due to Impulse of Vortex Rings on a Solid," following up inquiries suggested by Helmholtz's vortex theory.

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ELECTRIC LIGHTING APPLIED TO BUILDINGS.*

BY JOHN SLATER, B.A.

[For the purposes of this lecture, at which Mr. John Whichcord presided, the room was lighted by the Crompton regulating lamp, the Joel lamp, and the Swan lamp. These lamps were driven by a Gramme and a Siemens machine, worked by an Otto silent gas engine lent for the occasion by Messrs. Crossley Brothers.]

Mr. SLATER commenced by observing that an architect was nowadays compelled to have a much wider range of knowledge than would have sufficed for him a generation or two ago. This was particularly the case with scientific objects, as no one could tell how industrial arts or manufactures might be affected by scientific discoveries. Hence an architect was bound to take an interest in such subjects as soon as they appeared likely to have a practical bearing on his work. Electric lighting was precisely such a subject, and the object of this Paper would be to show how the architect might hope to take advantage of the discovery in his buildings and use it with success. The main divisions of the subject would be the following:—1. The means of producing the electricity. 2. The various systems of electric lighting in practical use. 3. The effects and advantages of the light. 4. The cost of producing it.

After giving a short history of the invention, and describing the first discovery by Davy of the light between carbon points, Mr. Slater showed that so long as batteries offered the only means of producing the electricity the cost of the electric light was practically prohibitive, and for many years it remained nothing but a striking and beautiful experiment. Faraday's discovery of induced magnetism in 1830 was a great step in advance, and this led to the invention of the electro-motor machines of Nollet and Holmes, which were speedily utilised for the production of the electric light for coast illumination. These machines were called magneto-electric, and in their construction permanent steel magnets were used. The more recent machines were of the type called dynamo-electric, in which permanent magnets were replaced by small electro magnets, and the invention of these machines was the result of the discovery made in 1867 by Dr. Werner Siemens, Sir C. Wheatstone, and Mr. Varley simultaneously, that feeble currents could be induced in a coil of wire by the residuual magnetism in any piece of soft iron that had once been magnetised, and that such currents could be made to react on the iron, and thus again on the coil, until they gradually augmented the strength of the magnetic field, and with it the intensity of the current in the coil, until it reached a very high pitch.

After alluding to the various dynamo machines which had been invented, and stating that the two most extensively used in this country were the Siemens and the Gramme, Mr. Slater gave a general account of the latter, which was illustrated by diagrams. The Brush machine was then referred to as being capable of sustaining as many as sixteen lights in one circuit, while the Bürgin, though the last invented, appeared likely to become a formidable rival to the Gramme. Before leaving this branch of the subject it was necessary to discuss the question of the best and cheapest means of obtaining the motive power for driving the electrical machines, and a comparison was instituted between water-power, steam and gas.

With reference to the second part of his subject the author remarked that the various systems of electric lighting could be broadly divided into two groups—the arc-light systems and the incandescent systems, while these also in turn could each be divided into two branches, viz., the systems of arc lighting using alternating currents and those using continuous currents; and the quasi-incandescent and incandescent proper. The Jablochkoff lamp was selected for description as using alternating currents; and the Crompton regulator lamp as using continuous currents, which description would apply, with slight variations, to the other regulator lamps, such as the Serrin, Brush, Siemens, &c. The necessity of burning good carbons was then alluded to, and reference made to the various makers. Of the quasi-incandescent lamps the Werdermann was described, but it was stated that till quite recently the applications of this system had been so few that it could hardly be said to have passed the experimental stage. Within the last few weeks, however, a lamp invented by Mr. H. F. Joel had been brought into public notice, which was a vast improvement on anything that had previously been done in this system of lighting. The peculiar feature of this lamp was that one of the electrodes was of copper. This lamp was superior in brilliancy to any of the incandescent lamps and almost equally steady, while its mechanism was such that any one could handle it without difficulty or risk. A number of the lamps could be burnt in one circuit. It had, however, the drawback of being rather wasteful of current.

The principal incandescent systems were then alluded to, viz., those of Edison, Sawyer-Mann, Lane-Fox and Swan, and Mr. Slater observed, after paying a warm tribute of admiration to the inventive genius displayed in many forms by the mechanician of Menlo Park (Edison), that it was much to be regretted that his admirers were unable to restrain within due limits the enthusiasm with which his achievements had inspired them, as there was certainly no real reason for the most extraordinary depreciation of gas shares which ensued upon the receipt of various telegrams from America reporting the success which had attended Mr. Edison's experiments. The lamp selected for detailed description was the one invented by Mr. Swan, of Newcastle, and its simplicity, steadiness and cheapness were pointed out, the author observing that he was confident that if electricity was to be applied to our private houses for lighting purposes it would be in some such form as this, as no one could desire a more beautiful light.

With reference to the third point, viz., the applications of the electric light, Mr. Slater observed that these were so numerous and of so varied a nature that it would be impossible to discuss them all, and he should therefore omit all reference to its use in public streets, lighthouses, vessels of war, mines, or for military purposes and marine signalling, and should confine his remarks to its advantages in buildings and for building operations. In the latter case the architect had here ready to his hand the means of carrying out important building operations in little more than half the time usually required, and the superiority of the use of electricity over that of large flaring gas lights was conspicuous; although engineers were more likely to avail themselves of the light for such purposes than architects, yet it supplied a great want for both. But architects were chiefly concerned with the interiors of buildings.

The conditions necessary to be observed for the effectual artificial illumination of an interior were not so simple as might be imagined, and varied in particular cases. A concentrated light was required in some cases, in others a diffused one, the latter being of much the more frequent occurrence, and as a general rule it might be laid down that the nearer we were able to approach to the effect of natural daylight in our artificial illumination the better it would be. The electric light had been shown by the spectrum analysis to be precisely similar in composition to sunlight. The question of suitable reflectors was then touched upon, and Mr. Slater observed that if one of the arc regulator lamps were hung a few feet away from the ceiling of a room, and the light, although itself hidden, were reflected upwards on the white surface of the ceiling, the result would be a diffused light over the whole room, much more agreeable than that given by the lamp itself. Some such system as this had been adopted at the Station of the Chemin de Fer du Nord in Paris, and at the Picton Reading Room in Liverpool, but such an application had not yet apparently become general. The advantages of the electric light over gas or oil were then enumerated:—1st, as to illuminating power.

The result of experiments made at the South Foreland Lighthouse showed that the electric light there displayed was equal to 8·31 times the light of the large six-wick Trinity oil lamp, which itself was equal to 722 candles, so that this would give 6,000 candles as the value of the light. The various arc lights in general use varied from 2,000 to 8,000 candles; the Jablochkoff lamp varied from 300 to 450 candles; Mr. Swan's little lamps equalled 30 to 40. The unsatisfactory nature of candle measurement was noticed, and a new method of measuring the intensity of the light by the area illuminated to a certain standard was alluded to, and details were given of the result of such a test when applied to various lights. 2nd, as to quality. Everyone was aware that in gas light the yellow rays predominated so largely that it was impossible to distinguish blues, greens and other delicate tints; consequently it was imperative that the decoration of rooms for use at night should be in strong colours not suitable for daylight. The reason for the excess of yellow in gas light was shortly stated. The invisible radiation in burning gas was very great, whereas it was very slight in the electric light, where the heat at the carbon points was so intense that all the colours of the spectrum were produced, the result being a light of great purity and whiteness. Hence its value for shops and factories where coloured goods had to be examined and sorted; also for picture galleries, while if its use became general ceilings would not become blackened nor decorations tarnished, and the danger of fire would be reduced to a minimum. As so little heat was radiated into the air with the electric light the temperature in its neighbourhood was but slightly raised, so that all rooms would be much cooler than under the present system of lighting. Calculations were given showing that one of the large arc lights of 4,000 candle-power

* Abstract of Paper read at the Royal Institute of British Architects, on Monday, 25th April, 1881.

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radiated rather less heat into a room than one good gas burner of 15 candle-power. It was unnecessary to dilate upon the great advantage of this in public assembly rooms.

Although as yet but few experiments had been made with a view of determining the effect of electric lighting on the acoustic properties of a room, it would probably be found that these would be greatly improved. Professor Tyndall had ascertained that waves of sound were interfered with far more when they had to pass through atmospheres of differing densities than when such variations did not exist. The heated currents of air in a gas-lit concert room must necessarily cause the formation of strata of varying densities, and this was probably the cause of the complaints which were occasionally made of the different acoustic properties of a room when used at night and in the daytime; so that in electricity the architect would probably find a valuable acoustic ally. The proper ventilation of rooms was next alluded to. Public rooms, particularly when used for large assemblies by gas light, were always difficult to ventilate adequately. Besides the oxygen consumed by the audience there was the abstraction from the air of the oxygen required to support the combustion of the gas. With electric lighting the conditions were quite different; the light was equally brilliant in a vacuum as in the air, and no oxygen at all was consumed by the glowing filament of carbon of the incandescent systems. There was a slight consumption of oxygen with the large arc lights, but careful calculations showed that a large arc light of 4,000 candles nominal power would abstract from the air in three hours only about six cubic feet of oxygen, while gas burners giving the same amount of light would in the same time consume 4,680 cubic feet of oxygen, or about 780 times as much as the electric light. This showed how vastly more simple became the problem of securing the efficient ventilation of a room when this enormous consumption of oxygen was got rid of, as the air would not require renewal so frequently, and, therefore, fresh air could be introduced much more slowly and draughts would be diminished. Equally beneficial results would attend the introduction of the electric light into private houses, workshops, factories, &c., and the sanitary condition of the workpeople and others employed would be materially improved.

It was natural that objections should be urged against the light. It was asserted to be flickering and too white, but it was shown that the flickering had been largely overcome in the later inventions; and as to its whiteness, no light was intended to be itself looked at but to enable other things to be seen, and the whiteness could at any time be obviated by using coloured glass shades.

The risk of accident was then alluded to, but Mr. Slater said he considered the risk infinitesimal and far less than that attaching to gas lighting. Allusion was made to the recent burning of the Opera House at Nice, in which case great loss of life would have been avoided had there been a separate source of light besides gas, for it was the sudden extinguishing of all the light at the first explosion that caused the panic which led to more deaths from suffocation than from burning. A formidable indictment could be framed against gas on the score of explosions, leaky pipes, frozen meters, &c., from which drawbacks the electric light was free, so that the slight objections against the latter, which were in many cases more ideal than real, seemed far outweighed by its numerous and great advantages.

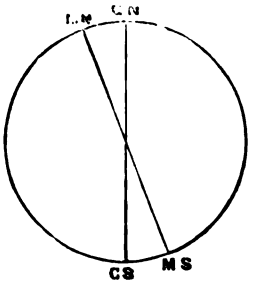
The question of the cost of the electric light was a very important one. Much depended on the motive power used for generating the electricity. When water power was available the cost would be extraordinarily low. Steam power came next in order of economy, and a gas engine was the most expensive. Details were given of various experiments, from which it was deduced that with a good steam engine a light of 204 candles could be obtained for every pound of coal consumed, while if the same light were obtained by turning coal into gas, even allowing for the return, as coke, &c., of half the amount of coal used, nearly eight pounds of coal would be required, so that electricity was eight times as cheap as gas. If electricity were generated by a gas engine the saving would be in the proportion of about 5·3 to 1. Various details were quoted of the actual cost of the light at the Albert Hall, British Museum, Alexandra Palace, and other places. The various incandescent systems had not been tried long enough to enable details to be given, but the improvements made all along the line during the past year warranted the indulgence of a confident expectation that the cost would still diminish.

The author then discussed the possibility of architects being able now to avail themselves of the electric light, and instanced the case of large country mansions, factories, hospitals, and other such institutions, where electric lighting could be established at less cost than gas lighting. The difficulties in the way of lighting a large number of private houses were much greater, as the question of distributing and measuring the electricity could hardly yet be said to be settled, but the efforts of Mr. Lane-Fox, Mr. Edison, and Mr. Swan in this direction would probably soon be successful. It was, however, absurd to predict the arrival of a day when the last gas tap would be turned off for good, as such an invention as gas could never become useless or unnecessary; but for the production of an almost perfect light, under certain conditions, gas could never hope to rival its brilliant compeer. Mr. Slater concluded his paper thus:—"Although it is eighty years since Science gave us this brilliant means of illumination, and fifty years since she supplemented that gift with another, enabling us to do away with the old and cumbrous means of producing it, it is only within the last few years that any progress has been made in the industrial application of the discovery; but during that time the advance has been so rapid and the improvements in every direction so great that he would be a bold man who should predict a limit to its future possibilities."

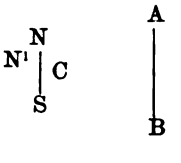
LESSONS FOR LEARNERS.

(CONTINUED FROM PAGE 247.)

Before we commence an experiment in which we use the tangent galvanometer, it is necessary to arrange the instrument in a particular direction. The coils of the instrument must be in the same direction as the magnetic needle would take when left free to move. This direction is called the magnetic meridian. "A vertical plane passing through the points on the horizon indicated by the needle is called the *magnetic meridian*, in the same way that a similar plane, passing through the north and south points, is known as the astronomical meridian of the place" (Dr. Ferguson, p. 17). If in the diagram M N M S represents the



earth's north and south magnetic poles respectively, the coils will be in the direction M N, M S. The current passing through the coils acts perpendicularly to this direction, and you will, therefore, easily see how it is that the influence of the current is not the same in every position of the needle. If A B N S represent the plane of the coil and the magnet respectively, C being the central point of the magnet, however N S be moved, the length of a perpendicular from N to A B must be changed, and this holds with every point in N S except C. The needle then being moved from its normal position by the influence of the current is subjected to less and less influence the greater the angle through which it is moved; but, on the other hand, the further the needle is moved from the position it takes when free to obey the influence of the earth's action, the greater is the influence of the earth's magnetism to pull it back into this position. Consider, then, these two actions in opposite directions. As the one decreases in effect, the other increases, so that it is easily seen a point must come when the forces balance each other and the needle is kept at rest. We do not, without a little calculation, get the absolute strength of a current by noticing the deflection of the needle, but the deflection of a needle allows us to compare the strengths of various currents very easily.



Here for example is a small and not very powerful battery, and you see by sending the current through this coil and through the galvanometer I get a deflection of 25°. The tangent of 25° I find is ·4663077.

There is a second and more powerful battery, by which I replace that first used. The deflection now is 47°.

The tangent of 47° I find is 1·0723687.

Now, I have told you that the currents are proportional to the tangents of the angles, and hence the currents we obtain bear the relation to each other as ·4663077 to 1·0723687; that is, the current in the latter case is, roughly, 2½ times stronger than in the former case.

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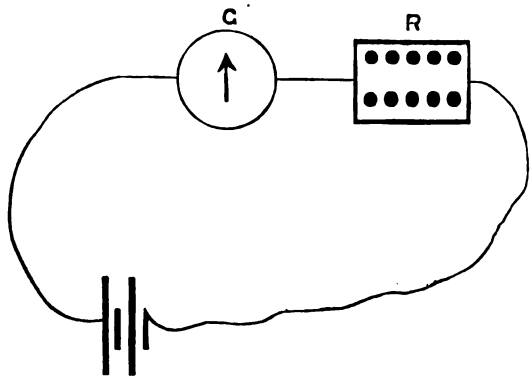
It is often necessary in practice to obtain a current of double strength to another current, and quite unnecessary to know the absolute strength of either current. This is a simple method sometimes employed to find the resistance of a battery.



I take this battery for example, and put it into the circuit with a galvanometer and resistance coils.

I unplug resistances till I get a convenient deflection, say 53°.

The tangent of 53° I find from the tables = 1·3270448, and 1·3270448 ÷ 2 = ·6635224.

The angle corresponding to this is found from the tables to be between 32° 33′ and 32° 34′, that is a little more than 32·5°.

In order to obtain a deflection of only 32·5° I must increase the resistance, and thus decrease the current, till I get the required deflection. Now, what resistance have we in the circuit?

1st. We have the battery resistance, call it r.
2nd. ,, ,, galvanometer ,, G.
3rd. ,, ,, coils unplugged ,, R.
4th. ,, ,, connecting wire, which we will neglect for the present, because the wires are short and thick, and, compared with the other resistances, very small.

Of these resistances we know G and R, while r is unknown.

The total resistance then is $(G + R + r)$ ohms.

Suppose G = 10 ohms,
R = 30 ohms,
r is unknown.

Suppose I unplug 60 ohms in order to halve the current, I have now in circuit G = 10 ohms,

$R' = 60 + 30 = 90$ ohms,
r is unknown.

$$\text{But } (G + R' + r) = 2(G + R + r),$$
$$\text{or } 100 + r = 20 + 60 + 2r),$$
$$100 - 80 = 2r - r = r,$$
$$\textit{i.e.,} \quad 20 = r$$

Thus the resistance of the original circuit was 60 ohms. The resistance is now $2 \times 60 = 120$ ohms, and in this case the tangent of the angle deflection is halved.

You can now, as a holiday task, read carefully chapters I., II., and III. of Mr. Kempe's book on Electrical Testing.

ATMOSPHERIC ELECTRICITY.

An account of two interesting cases of electric discharge in the atmosphere have been communicated to the French Academy by M. Frécul. It appears that on the 25th of August last, during a thunderstorm, he saw in broad day a very brilliant, luminous "fireball," of a yellowish-white colour, issue from a black cloud. The shape of the ball was elongated, and its apparent dimensions were 35 centimetres long by 25 wide, with the two ends brought to a cone.

It was only visible for some moments, and vanished in seeming to re-enter the cloud; but when it first emerged from the cloud it shed off a small portion of its substance, which *fell vertically, like a heavy body*, as if it had been under the influence of weight. This emission left behind it a luminous train, on the borders of which were manifested sparks, or rather reddish globules, for their light was not radiant. Near the falling body the luminous train was almost in a right line, whilst in the upper part it became sinuous. The small body broke up as it fell, and vanished when it was near the house-tops. Neither when it first appeared, nor when it went out of sight, was any sound heard, although the cloud was not far distant.

The most interesting point about this fireball is that it seems to have been partially, at least, composed of ponderable matter, which was not projected violently by an explosion, nor accompanied by a noisy electric discharge.

The next fact which M. Frécul recounts is of a very different kind, and has been observed by him nearly every year for some time. It presents itself also during thunderstorms, but it has no place in the region of clouds. It shows itself at a slight distance above the surface of the ground. No mention of it is to be found in Arago's papers on thunder, or those of M. du Moncel. Arago cites three orders of luminous phenomena appearing near the earth's surface. These are, 1st. St. Elmo's fire; 2nd. Fiery bodies which are generated on the surface of the ground, rise to a small height and disappear with an explosion; 3rd. Lights which appear on the surface of water.

All these persist during some time; but those which M. Frécul has observed are instantaneous as a flash of lightning; he has, in fact, seen from the height of the first flat where he lives the air illuminated throughout the whole length of the Rue Linné, Paris. This was not by day. The light was very feeble, of a yellowish tint, and its intensity was far from equalling the sheet lightning in the region of clouds. Sometimes it occupied the whole width of the street, and resembled a luminous curtain several yards wide; sometimes it only formed a narrow band, forty or fifty centimetres wide, which did not quite cross the street. The feeble luminosity of this form of discharge may have prevented its being recognised sooner.

THE ELECTRO-TECHNICAL SOCIETY OF BERLIN.

At the last meeting of this society the President announced the resolution of the committee to take part in the forthcoming Electrical Exhibition at Paris next summer. The society has also resolved to appoint a special committee for the systematic observation of earth currents and their influence. It was further stated at the meeting that 113 applications had been made for private telephones in the city of Berlin. A paper was read upon "Electro-endoscopy." The lecturer (Dr. Weise) pointed out that the artificial illumination of certain portions of the body had of late years been increasingly employed for the purposes of medical science. Every year showed additional progress in this direction. The lecturer described and performed experiments with the apparatus invented by Nitze and Leiter, with optical appliances contrived by M. Beneche. By means of these instruments the physician is now able to examine the condition of the stomach, &c., of a patient. On a former occasion a lecturer had, by help of the Trouvé apparatus, shown the interior organs of a pike. The fish, which was swimming in a small aquarium, had a probe passed into its stomach, and by help of a glass lens the lecturer obtained a representation of the pike's stomach through the agency of the electric light. Indeed, the stomach was clearly visible as a translucent glowing red object, while the whole of the interior middle part of the fish was reflected in a reddish light. The defect of the Trouvé instrument is that it contains no optical apparatus showing the interior cavities of the body in their various parts, while the platinum wire introduced into the body is liable to inflict injury in consequence of the heat developed by the electric current. These disadvantages are avoided in the Nitze and Leiter apparatus, in which the platinum wire is kept cool by help of a stream of water. The construction of the apparatus, except the optical portion, which was made by M. Beneche, of Berlin, was carried out by Herr Leiter, of Vienna. Any battery, as, for example, a Bunsen, may be employed, and the current carried thence to the probe. The probe itself is of metal, of two parts, formed by a strip of platinum, which, on the passage of a current, produces the illuminating effect. Thin as the probe is, it contains two small pipes, conveying the stream of water that cools the platinum; and, in addition to these, finds room for the optical apparatus besides. The stream of water does not actually come in contact with the platinum, but only neutralises its outward effect. The optical apparatus decreases to some extent the size of the objects it shows. The most difficult apparatus to construct is that for the examination of the stomach. Dr. Weise showed probes as used in the examination respectively of the urinary canals, the bladder, the larynx, and the nasal and other cavities. In a discussion which followed, Professor Rosenthal recommended the use of dynamo-electric motors, but it was replied that German doctors found them too dear. At the close of the meeting it was announced that, with the laying of the underground cables from Stettin to Berlin, and from Aix-la-Chapelle to Cologne, the German Subterranean Telegraphic system was complete. Eighty of the largest towns in the Empire are thus brought into intercommunication through their direct connection with the capital.

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TECHNICAL EDUCATION.

The movement that may be said to have been set on foot but a year or two ago for the promotion of technical knowledge among the artisan classes shows no signs of abatement, and we are glad to receive from various quarters intelligence which assures us of its final success. The cause of educated workmanship has been advocated with universal approval, and it now only remains for the responsible communities of industry to see that it is efficiently realised. Art Schools have done immense service in the short space of ten or fifteen years, and schools of science might do quite as much in the same space of time. The objects are very different, and the patrons are of quite a distinct class; but when we remember the interests involved in this enterprise, and the keenness with which the British manufacturer usually takes up any proposition likely to recuperate him for his outlay, there ought to be no misgiving as to his hearty co-operation.

For the present, however, we are content to see the great guilds and corporations taking charge of these interests; and foremost in this good work is the City of London, whose programme for the summer classes at the Cowper-street Schools we printed last week. Since its formation some fifteen months ago, the scheme has shown such evident promise of success that a sum of money large enough to cover the cost of a Central Technical College in Finsbury has already been subscribed. The attendance at the classes has been highly encouraging so far, and the subjects chosen for the forthcoming session, which commences on Monday next, are at once practical and attractive.

Confining our remarks to the electrical part of the syllabus, we observe that a prominent place is given to the construction of apparatus. Here we have an illustration of how the workman and mechanician may be benefited by true knowledge of the purposes to which the apparatus under construction are to be applied. That a best form of instrument is seldom constructed is due, not to the workman's inability to make it, but to his ignorance of the rules that ought to be observed in making it—in other words, to his understanding too little of the nature and properties of electricity. The best conceived appliance possible may be spoiled or impaired by some trivial oversight or inadvertance on the part of the workman, and the importance of getting proper instruction for him ought to be as evident to his employers as to the workman himself. A large field of operations is now opening up for telephones—to instance one branch of the subject only—and their every detail should demand the utmost care and nicety, so that each instrument may work up to its highest attainable capacity.

The electric light is, if possible, a still more interesting and profitable study just now. The construction of lamps, the manufacture of carbons, the economies of generators, even the special qualities of steam engines, are all subjects capable of being taken up and studied separately. Indeed, if the electric light grows in popularity at the rate it has done of late a separate industry will spring up in respect to every one of these details. There are already a large number of companies formed for promoting the application of the new illuminant, and their *employés* would do well to profit by the course of instruction which the City and Guilds of London have placed within their reach. It will be seen that the hours are conveniently distributed during the day and evening so that few persons need be entirely hindered by their working engagements.

We have heard with some interest that certain of the classes during the past Session have been attended by females; and we are informed that if the number increases to any large extent arrangements will doubtless be made for their separate instruction. Happily the question of female professional education, which in some directions has met with considerable opposition, is in no way concerned with the unexceptionable subjects of the Cowper-street curriculum. Women may study electrical science without risk of alarming anybody or of doing any harm to themselves. We by no means grudge them their aspirations—whatever they may be—in this branch of learning, and we shall be curious to see what comes of it. It is one of the marks of this age that women are, many of them, desirous of sharing some of the professional honours which have hitherto fallen exclusively to men. The fact is so, and it is idle to close our eyes to it. Its essential fitness or unfitness can only be proved by the test of experience. Sensible men may, therefore, be content to let the experiment have free play; and for this reason, if for no other, they may be glad to hear that technical education is being offered to and accepted by the other sex. The main object, however, of institutes such as this we have been chiefly commenting upon is to help forward those industrial manufactures in which men alone are engaged; and commencing, as they have done, in such a hopeful manner, we sincerely wish them a prosperous future.

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LAYING AND REPAIRING SUBMARINE TELEGRAPH CABLES.*

BY A. JAMIESON, C.E.

(CONTINUED FROM PAGE 291.)

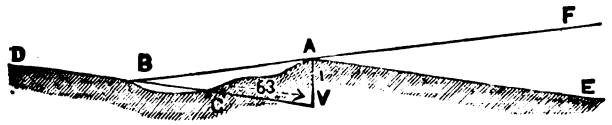
A great many attempts have been made by different engineers to devise a better form of sounding lead than Sir W. Thomson first brought out, as with it you had to drop the sounding shot in deep water, although you generally managed to bring back the tube, but without a very good specimen of the bottom. I tried to do so, and succeeded to a certain extent, but the one before you designed by Mr. Lucas (one of the chief telegraph engineers of the Telegraph Construction and Maintenance Company) is the best and most perfect yet devised. It brings up half a wine glassfull of the bottom from almost any depth, and is in reality a most serviceable tool in connection with Sir W. Thomson's sounding machine.

Well, the telegraph ship proceeds over the proposed ground for the cable, and those in charge take a series of soundings, carefully noting the depth, nature of the bottom, position of these by latitude and longitude (or bearings and angles if within sight of land), marking every detail and circumstance, including currents, upon properly-prepared charts. The whole data is carefully weighed, and the best route chosen, avoiding a rocky and irregular bottom. A section of the sea bottom is drawn to scale in order to ascertain how much slack should be allowed at the different positions. For, as I explained a few minutes ago, if the cable does not rest upon the sea bottom at all points, a constant strain comes into play, which in time inevitably kills or breaks the cable, stopping communication till repairs can be effected.

[In a report made by the eminent firm of telegraph engineers, Messrs. Clark, Forde, and Co., the following passages occur relative to the breaking of cables suspended on rocky points :— On a rock bottom short lengths of the cable must clearly hang free over the smaller interstices of the rock, but a cable may also in certain circumstances, we consider, be left suspended for considerable lengths, even if a large per centage of slack is being paid out; for instance, the cable in question at an ordinary paying out speed of five knots an hour will sink in a straight line, inclined at a slope not exceeding 1 in 6·3 to the horizon, so that in a depth of 1,000 fathoms the cable will touch the bottom about 6·3 knots astern of the ship.

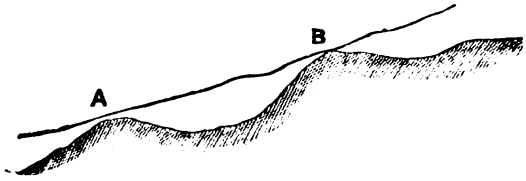
If anywhere the bottom has a slope exceeding this amount it is clear that the cable will be at first suspended, and then will gradually fall to the bottom if it is able to drag up slack enough.

If the contour of the bottom is like D B C A E the cable will at some instant take the position B A F, and at the instant of touching A, B A is, of course, tight if there is any strain on the



cable at the ship's stern. The piece A B will then tend to fall in the ground below it, and to do this must gather slack from A E or B D. It is possible that the cable may on rocky ground catch on rocks both at A and B, and then it will remain suspended, possibly under great strain. The strain will depend on the length A B, and the distance along B D A E that the cable has dragged.

Should the ground prevent a contour such as that shown below, in which there is a general ascent not less than 1 in 6 for some distance, and on this slope any two summits as A B



exist, the cable will touch the points A and B at the same instant, and should it catch at both then will remain suspended, under very great strain, however large a per centage of slack may have been paid out.

When the slope of the bottom is quite even it appears that

2	per cent.	of slack	is sufficient for an ascent of		1 in 5
4	,,	,,	,,	,,	1 in 3·5
6	,,	,,	,,	,,	1 in 3
8	,,	,,	,,	,,	1 in 2·5
16	,,	,,	,,	,,	1 in 2·25
41	,,	,,	,,	,,	1 in 1

* A Lecture delivered at the Naval and Marine Engineering Exhibition, Glasgow, January 29, 1881.

The only way to partially meet this difficulty is to pay the cable out slowly, so that it may fall at a comparatively high angle, and to pay out a considerable per centage of slack."—ED. *E.*]

We now return to Mr. Jamieson's lecture. He went on to say:—

Having obtained this careful survey, the shore end is landed by fixing or burying a strong heavy anchor in the ground in as elevated a position as possible, with a large snaith block or pulley attached, close to the intended cable house and beach, running a strong light rope on shore with boats (having first brought up the ship to a position as near the cable house as possible, and anchoring her stern on to the shore), passing the end of this rope through the shore pulley or block, and returning the loose end of the rope on board again.

This end of the rope is now firmly bent on to the end of the cable, which has been previously passed out of the ship's cable tank, and the inner end of the rope is now hauled upon by being passed several times round the picking up drum, and the machinery set in motion. As each successive 50 or 60 fathoms of cable is hauled out of the ship towards the shore, it is bent on with a piece of spun yarn to small light draught buoys, or attached to the bows of ordinary boats, until it reaches the shore, and the end passed into the cable hut. In this hut are two or three electricians with a cable jointer, who attach the core of the cable to their testing instruments. These electricians now communicate electrically with the electricians on board, test the cable carefully for conductivity and insulation resistance, and, if all right, the men are ordered to fill up the trench between the cable hut and the shore, the buoys cut adrift are picked up and brought on board. The ship now lifts her anchor, and the laying of the cable is proceeded with at once, slowly at first, until everything gets into working order, but afterwards, when type B (shown), or a depth of 50 fathoms reached, at five to six knots an hour, even more at times.

Each individual on board (from the cabin boy to the captain on the one hand, and the men in the tank to the chief engineer and electrician) now has his special work and duty to attend to, and in a well arranged expedition no hurry, fuss, or unusual excitement of any kind should be observable.

Some ten men in the tank, with a leading hand, carefully watch and assist the cable in freeing itself, as each coil whizzes out, and it does whiz at what would be considered a dangerous rate by any one not accustomed to the operation. It is a most dangerous thing not only to the men engaged in the tank, but to others along the line of cable, should a "foul fluke" occur—*i.e.*, one coil catch another, and lift it in a bight, for the cable being strong and capable of bearing at least several tons' strain, would carry everything before it, perhaps killing the men, breaking machinery, and getting inextricably mixed up, if not broken itself. I once saw a bad case of this—fortunately no one was killed—but I do not wish to see another. Well, the men in the tank are relieved every two hours if the tanks are small, good mechanics attend to oiling and clearing the machinery from dirt, and one is specially stationed at the brakes, to adjust the proper strain, according to the directions and calculations of the engineer in charge.

He watches this dynamometer or machine for indicating the strain on the cable, and as it rises or falls he turns the handle of a winch in order to ease or screw up the brakes, which are fixed on the same shaft as the paying-out drum. I have here had the dynamometer drawn to scale, and the necessary mathematical calculation for dividing or marking off the strains worked out. It is a simple problem in the parallelogram of forces, which I shall not go into this evening. The rotometer is carefully watched to know the lengths paid out, &c.

The electricians in the testing rooms, both on board the ship and on shore, keep up a constant searching inquiry (which, unfortunately, there is no time to explain this evening), so as to obtain all necessary electrical data for future use in case of faults occurring, and to detect the slightest appearance of a fault should it occur, when orders are at once given to slow or stop the ship if necessary.

On the bridge the captain, with the assistance of a special navigating officer on the engineer's staff, notes all bearings, takes numerous sights, and marks all courses and distances, while the ship's engineers keep the ship going at the speed required by the engineer in charge of the expedition.

The whole operation goes on like clockwork until the opposite shore or landing place is reached, when the same operation of landing the other shore end takes place, if it has not been done previously. If so, the ship is brought close up to the buoyed end, and the final splice made. If all is electrically perfect the health and prosperity of the cable is drunk, and complimentary messages flow through at lightning speed.

Final shore tests are taken by electricians at both ends to

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prove already obtained figures, and to satisfy the consulting engineers, while daily tests are taken for a stated period (generally during one month's guarantee) in order to see that nothing goes wrong, or to give warning should such unfortunately occur.

Working the cable or the transmission of telegrams is also busily effected when the cable is not being tested, and it begins its useful life, to gladden many a heart by joyful news, or sadden others by the reverse, but above all, if possible, to enrich the bold speculators who launched the scheme of connecting previously unconnected lands.

We now have to deal with "Faults: How they Occur, and How they are Localised." We may enumerate the causes of "faults" as follow:—

1. Total breakage due to abrasion, suspension between submarine eminences, insufficiency of slack, volcanic eruptions, or terrestrial disturbances, or possibly large masses of rock becoming detached and falling across the cable in descent.
2. In shallow waters, from ships' anchors.
3. Faults caused by teredos, or marine animal borers.
4. Break of the conductor, with perfect or good insulation.
5. Latent faults in the cable when laid, developing after time, deterioration of core, joints, or sheathing.
6. Lightning.

Firstly. With regard to breakages due to abrasion, this cause is mainly attributable to the cable being swayed to and fro, under the influence of tides, currents, &c.; and where these are likely to occur, the only means of guarding against them is that of submerging the cable very carefully, so that it may suit itself to the configuration of the ground, and using a heavy type of sheathing. The fault of suspension is clearly due to insufficiency of slack; hence the great importance of a thorough knowledge of the ground over which a cable has to be laid.

Volcanic eruptions or terrestrial disturbances are actions over which we have no control, and for which at present no visible means of provision can be made, except that of using a heavy type of cable where they are to be apprehended.

Secondly. Cables are frequently damaged and broken by ships' anchors in shallow waters. This danger can only be lessened by using as heavy a type of cable as possible, and carefully marking off the ground by buoys or otherwise, and as far as possible avoiding anchorage.

Thirdly. The frequent injury to the core from the attacks of teredos, or other marine animals, may be guarded against by coating the core and servings with some anti-teredo substance, which will either be fatal or distasteful to these obnoxious animals, and which at the same time may have no deteriorating effect upon the core or cable. Various means have been proposed with this object in view, such as covering the core with powdered glass, brass, or copper tape, and saturating the servings with andiroba oil.

Fourthly. Cases of interruption from a broken conductor with perfect or good insulation frequently occur, often in joints, but more frequently in the main conductor, due to an overstraining of the copper wires in manufacture, or in paying out, or perhaps brittleness of the copper. The simple remedy for this kind of fault is to be found in taking great precaution to have the copper of the conductor thoroughly annealed, and capable of bearing a certain strain with elongation before breaking, and being careful not to put more strain upon the same when twisting it into a conductor than is absolutely necessary to form a good lay; so regulating the core and outer servings that they will take up any strain to be afterwards put upon the cable before the conductor. All india rubber cores are liable to break their conductor from excess of elasticity in the india rubber when strained.

Fifthly. As regards provision against a latent fault in the cable when laid developing itself after time, or a deterioration of the core and joints or sheathing, we must look for a remedy in a thorough system of electrical and practical testing during manufacture and coiling from factory to ship; and *too* much care cannot be taken in having each mile of core and cable thoroughly tested, as well as every joint and bundle of wire of which the cable is composed, for it is only by so doing that all the future annoyance and expense arising from latent faults may be avoided.

As regards the Sixth cause, viz., lightning, the remedy may be looked for in a good system of lightning guards, and in carefully earthing the cable ends when an unusually severe thunderstorm occurs. Cases of interruption or fusing of a cable conductor are fortunately of infrequent occurrence, and I only know of four well-authenticated instances.

When from any cause a submarine cable is broken, or becomes too faulty for the transmission of messages, a repairing ship, fitted with all the necessary appliances for grappling and lifting the cable, is despatched with the least possible delay to the position localised by the electrician.

(TO BE CONTINUED.)

CORRESPONDENCE.

STRAY THOUGHTS ON THE HELMHOLTZ LECTURE.—I.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: A lecture "On the Modern Development of Faraday's Conception of Electricity," by so distinguished a foreigner, is an event which may justify a few free notes as to the points dwelt upon and the manner of treatment.

Faraday took a leading part in clearing up many points connected with the nature of electricity and magnetism, subverting all vague ideas of action at a distance by a clear elucidation of "the lines of force," acting from atom to atom, however invisible, by which electrical or magnetic forces are transmitted. That all this was done without the help of a single mathematical formula, and by a rigid preference to facts, with the least possible use of hypothetical substances or forces.

That the highest powers of mathematical analysis by Clerk Maxwell and others have now shown how great a degree of exactness and precision was involved in his conceptions of electrical and magnetic phenomena.

Referring to the second great problem of Faraday's research, viz., the connection between chemical and electrical forces, the Professor claims to use the language of the old electro-chemical theory of Berzelius, maintaining that the dualistic conception of positive and negative constituents remains valid to this day in the main facts of chemical combination, and more especially in the definite law of electrolytic action.

It is only in the concluding and worst part of the lecture that the term "molecule" is used, and in addressing the *élite* of our English chemists it might well seem desirable to pay some compliment to what they cherish as "modern chemistry. The attempt is unfortunate, and might well induce the thought that, not being a chemist, "perhaps he had already gone too far."

The real object, however, "to kindle anew the interest of chemists for the electro-chemical part of their science," might well atone for shortcomings which dwindle into insignificance as compared with the exalted character of the lecture.

There is a lofty vagueness in the treatment which would make the above outline to be truly ridiculous, if offered as any adequate summary of the many grand points dwelt upon.

To great men like Berthelot, Sainte-Claire Deville, Cahours, and many others of their calibre, it must be as strange as it is refreshing, to hear the fundamental principles of the "old dualistic theory" enunciated, not only in England and at the Royal Institution, but before the *élite* of our English chemists.

The allusion to diamagnetism is perhaps both vague and unfortunate. "In 1849 Faraday demonstrated that all ponderable matter may be magnetised under the influence of sufficiently intense magnetic power." This might be acceptable if it means that the polar force of magnetism finds different susceptibilities or conductivities in different substances, but whatever can we make of the following? "At the same time he discovered the phenomena of diamagnetism, which indicated that even space, devoid of ponderable matter, is magnetisable."

Of such space we know nothing, nor can we by any means fix the limits of ponderable matter. The phenomena was discovered by Becquerel in France, some twenty years before Faraday took up the subject with great zeal, coining an unfortunate term, not without some tinge of unamiability to the discoverer, and with much of mistaken hypothesis, to be abandoned in his later researches. This false theory was taken up by Tyndall, Poggendorff, and other physicists, and elaborate experimental, and mathematical researches prosecuted, all of which Faraday stoutly resisted, almost to a quarrel with Tyndall, who exhibited before the British Association a complicated arrangement, to prove the different or antithetical polarityof diamagnetism.

It is marvellous that Faraday did not see the plain secret of mistake and invalidity in the Tyndall apparatus; but, nevertheless, he most sturdily and correctly maintained that all such endeavours did not go beyond the previously demonstrated facts, that *magnetics* tended to a position in the strongest lines of force, while diamagnetics tended to place themselves in the weakest lines of force.

Now that these matters are more clearly understood, we might paraphrase the final contention of Faraday as thus:—

Magnetics, or good conductors of polarity, are attracted into the lines of strongest force. Diamagnetics, or bad conductors, are deflected into the lines of weakest force.

Iron is enormously better conducting than air. Bismuth is slightly worse conducting, and hence the feeble character of the differ ntial results. Faraday and others have done much to compile tables of magnetic and diamagnetic values, all of which

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are a great mistake in phenomena of so purely a relative character.

We suspend a tube of iron solution in a vessel of weaker solution placed between the poles of a powerful magnet. The lines of force condense in the tube, in the ratio of its better conductivity, and therefore it is attracted into the axial position, or in the lines of strongest force. We next pour into the vessel a stronger solution of iron. The lines of force diminish or open out in the tube, in the ratio of the better conducting medium, and it is pushed into the transverse position, or that of weakest force.

How the followers of Tyndall can find it in their hearts or heads, to assume that the slight differences in the number of the lines in the two cases can determine that one is a magnet with normal polarity, and the other is a diamagnet with opposite polarity, is quite surpassing comprehension; the more so as they are both one and the same substance placed in slightly differing conditions. And how it was that Faraday, in originating these beautiful experiments, did not see that the great Tyndall experiment did not otherwise than fully answer to these conditions is still more incomprehensible.

However, posterity will highly appreciate his sturdy disbelief in all the learned mathematical and other complications by which he was surrounded, and for the time overwhelmed.

Of late years his opponents have been very silent, and it is high time that the manuals of science were altered in honour of his great fame.

The peculiar vagueness of treatment seems aggravated by clerical mistake or imperfect translation; but very much is due to the confused ideas of over-strained hypothesis in regard to the electrical character of chemical forces. This is the more strange or regretable as the evident course of modern thought is in an opposite direction.

He admits that Joule and others after him have proved experimentally that, if no other work is done by the current, the total amount of heat evolved in a galvanic circuit is exactly equal to that which ought to have been generated by the chemical actions which have been performed in the given time.

There are scintillations of a giant mind; but many of the statements in regard to the connection of electrical with chemical forces have long been comparatively commonplace, and are, indeed, rendered much plainer in Sprague's text book of electricity.—Yours, &c., SAML. E. PHILLIPS.

16, Greenwood-terrace, St John's, Hackney.

ELECTRIC LIGHT IN HOLLAND.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: While perusing your valuable paper of the 23rd April, I happened to learn from it that our "land of water had caught the fever," this being the cause, or perhaps the result, I don't know, of a shop in the Hague being illuminated by electric light.

Your correspondent has likely been startled at so extraordinary an enterprise of a phlegmatic Dutchman.

But in order that your readers may not be misled as to what is going on in Holland in the way of electric lighting, allow me to state that Mr. W. Smit, of Hikkerveer, had manufactured for some years excellent dynamo electric machines, with which several manufacturers and shops here have been provided, and which answer so well that, judging by the regular and steady light they produce, anybody would come to the conclusion that there is nothing feverish about either light, land, or water.

Hoping I have not trespassed upon your valuable space too much, I remain, &c., MURK LELS, JUN.

Kinderdyk, Holland, 26th April, 1881.

LAMP STAND.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I notice in *Nature* of 7th inst. a description of an "Improved Arrangement of Scale for Reflecting Instruments" by Mr. F. Jacobs, of Messrs. Siemens, Bros., Charlton, who showed one of these scale stands at the Helmholtz *soirée* of the Society of Telegraph Engineers and of Electricians a few days ago.

There are certain advantages in this form of apparatus, but there are also disadvantages, one of the principal being the difficulty of reading the image on the ground glass unless the room be darkened more than is necessary with the ordinary form of stand.

There is, however, nothing new in this invention; the original idea is, I believe, due to an American gentleman. The matter was brought to the notice of Messrs. Elliott Brothers about four years ago by Mr. A. G. Dew Smith, of Cambridge, and since that time several have been made almost identical with the stand described by Mr. Jacobs.—Yours, &c., WILLIAM O. SMITH.

101 and 102, St. Martin's-lane, W.C

THE FUTURE DEVELOPMENT OF ELECTRICAL APPLIANCES.*

BY PROFESSOR JOHN PERRY, B.E., ASSOC. M.I.C.E.

(CONTINUED FROM PAGE 298.)

When we think of electricity as an agent by means of which energy may be transferred and altered, it is natural to ask if, by means of it, energy can be stored up. If we could obtain an efficient method of storing energy, the result would be of very great importance in a variety of ways. Thus, if all the work obtainable from the tide filling and emptying great shallow basins could be stored up, so that it might be given out steadily, and only at our pleasure; if all the work obtainable from wind-power, which is constantly varying, could likewise be stored up, so as to be readily available, a long-standing difficulty would be got rid of, which has hitherto prevented the working out of large schemes for the utilisation of these sources of natural power. And not only in these large cases but in a countless number of other ways is it important to possess means of storing energy. In the manufacture of gunpowder, and in many chemical operations, energy is stored up, but no such method can ever become economical. It has to be remembered, however, that electrical operations may be made as economical as we please; and however insignificant the method may appear to be just now, it may assume great importance in the future, from the fact that, with the exception of the lifting of heavy bodies to higher levels, an electrical method of storage may be made more economical than any other. Now when I charge this Leyden jar (experiment shown) you know that I store electrical energy, and I can use my stored energy at any future time if the insulation of my jar is good. Thus I have converted a small store into heat and light. (Experiment shown.) Again, I can use this store at any time to give itself out at a distant place. This is a very small store. But now observe that my thermopile has been working for nearly an hour, and some time ago it had filled these two test tubes with oxygen and hydrogen. With these two gases I can produce, as you all know, a most intense heat. You all know that this lime light is produced simply through my having such a store in these iron bottles which you see before you. Remember that these gases might be kept stored up for as long as we like, and that if a windmill worked a magneto-electric machine it could produce such a store, working now fast, now slow. Well, but I can take this store and convert it again into electricity with very little loss. You will see that it can produce an electric current if we have two similar metal plates in the positions you see them in, and if I connect these metal plates through the galvanometer (experiment shown), you have there evidence of a current, this deflection of the needle of the galvanometer. This current will continue to flow, and the electric energy will continue to be given out until all the store of gas disappears.

Instead of using that weak thermopile, suppose I had used this strong current produced by the outside engine, you see how much more rapidly my store is formed. (Experiment shown, in which the gases rapidly formed were used to produce an oxy-hydrogen lime light.) I grant that the elaboration of this gas battery into a compact generator sufficiently powerful to produce very large effects, is a problem of some expense for future workers; but give it to any electrician, and make it worth his while, and I believe that such a generator might be constructed in a very short time.

To introduce the next part of my subject, let me ask, Can anybody hear the sound made by a puff of air as it passes through the hole in this cardboard disc? (Experiment made.) Nobody heard it, or the difference produced when the air was stopped by the cardboard. But suppose I repeat this operation several hundred times per second, you can all hear the powerful musical note given out. (Experiment.) You see, then, that the rapid recurrence of effects may be very sensible to us, although one such effect may not be sensible. In the same way, if light streamed through one of the holes in this brass disc into your eyes, it would not produce a very striking effect; whereas Professor Tyndall says that when such a disc as this was rotating so as to let the light falling on his eyes be very rapidly intermittent, he experienced the most extraordinary sensations. Again, if I very much alter the magnetic field in this telephone, by bringing a powerful magnet near it, with great care in listening I hear the faintest sigh, due to the diaphragm settling itself into a new position, its vibrations dying away as it does so; and if I brought a small magnet near, I should hear nothing. And yet the change of magnetism which produces the loud telephonic effects which we listen to is almost infinitely smaller. Why is this? It is due to the rapid recurrence of the effects. Now you

* Paper read before the Applied Chemistry and Physics Section of the Society of Arts on March 24th, 1881.

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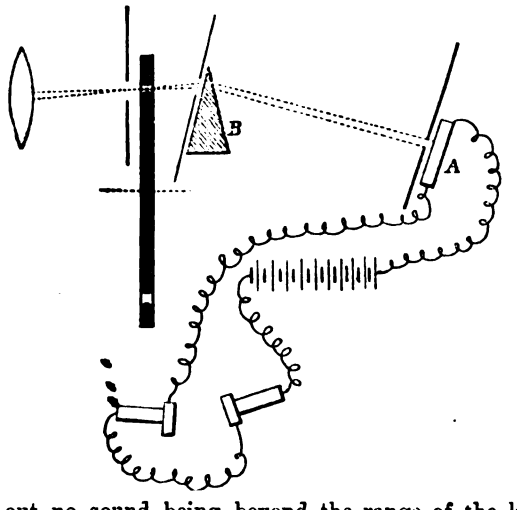
are all aware of the importance of the telephone as a method of communication; I believe that a much greater importance is in store for it as a laboratory appliance.

Here is a selenium cell through which I can pass a current of electricity from this large battery, which also passes through these two telephones, which I can hold to my ears. When light falls on this selenium its electric resistance is diminished, and a stronger current passes. This is a property discovered by Mr. Willoughby Smith. Now I cannot hear in the telephone any effect produced by letting light suddenly fall on the selenium. The difference of current produced in the very case before you is only one two-thousandth of a weber. But if I rotate this brass disc so as to make the light fall with intermittence several hundreds of times in a second on the selenium, I can distinctly hear a musical sound. This is what Professor Bell has been exhibiting lately, and it constitutes the principle of the photophone. Now to give you an idea of the new ground which the use of the principle of recurrence is opening up in laboratory work, let me speak of an experiment which is now in progress. Professor Bell spoke in his lecture of having tried to stop the intermittent rays of light of this instrument by a sheet of ebonite like this, but he found that there was still a very faint sound from the telephones. Well, it occurred to Professor Ayrton and myself that if ebonite is transparent to some kind of invisible radiation, then in all probability it is capable of refracting such invisible rays. So we obtained this ebonite lens, and two prisms, and tried. We thought the lens would bring the invisible rays to a focus, but as our lens was not mounted, so that we could move it parallel to itself, and as the rays are, of course, quite invisible, so that our eyes cannot help us to focus the ebonite lens, we did not succeed in this very delicate experiment, which the following experiment however shows must ultimately be successful. Next we placed the cell at A in this diagram (Fig. 1), and found that

FIG. 1.



it gave out no sound, being beyond the range of the beam of intermittent light. We placed the prism in the position B, in which you see it, and, to our great satisfaction, a sound was heard. You must remember that this sound, and any sound obtained from light that had passed through ebonite, was exceedingly feeble. The person who listened was in another room, so as not to be in any way influenced by what he saw, and his preciseness in detecting sound was determined by another experimenter putting his hand in the beam of light and taking it away again. So that there could be no doubt as to the origin of the faint sounds heard. Well, the prism caused the light to bend round, and now the question was as to how much bending it produced. We provided two pieces of zinc plate, with slits cut in them. You all understand, I hope, that the most advanced physicists regard a metal as a perfectly opaque body, even to invisible rays, so that rays can only pass through the slit in our zinc. Well, we placed the slit in the zinc within a short distance of the edge of the prism, and found a position in which the rays, passing through the slit, still reached the selenium. The sound was now very faint. Then we searched on the selenium with the edge of our second piece of zinc, to find what region of the cell might be covered without destroying the sound. We found that region, and placed our second slit there. Rays passing through the first slit were now passing through the second slit. If either was changed in position, the sound died away instantaneously. Thus, there could be no doubt of the fact that ebonite refracted that invisible beam, about which nothing else is as yet known. If our slits had been very narrow we could have measured accurately the index of refraction, but with narrow slits the sounds were too faint to be heard in the centre of London; so all that we can say at present is that ebonite certainly refracts light, and its index of refraction is, speaking quite roughly, 1·7. Now, it is somewhat curious that this was the rough measurement which we made. For Clerk Maxwell's theory, that light is propagated through space like an electromagnetic disturbance, requires the square of the index of refraction, for light of very low refrangibility to be equal to the electric specific inductive capacity of the substance, and it has long been known that this electric constant for ebonite varies from 2·2 to 3·5 in different specimens. The square of 1·7 is 2·89. Thus, you see that this curious following out of our first idea has led to a further backing up of Clerk Maxwell's electromagnetic theory of light. The particular selenium cell we employed was kindly lent us by Mr. Bidwell, as those which we had made, although sensitive to light, had too high a resistance. This investigation and others which we are now proceeding with illustrate two important things, namely, the principle of recurrent effects in the use of the telephone has opened up a new path into unexplored nature; and, secondly, the laboratory worker sees before him a hundred interesting phenomena, which ought to be investigated at once, and which he cannot take up unless he gets more apparatus, more money, and more observing eyes and working hands.

About two years ago it struck Professor Ayrton and myself, when thinking how very faint musical sounds are heard distinctly from the telephone, in spite of loud noises in the neighbourhood, that there was an application of this principle of recurrent effects of far more practical importance than any other, namely, in the use of musical notes for coast warnings in thick weather.* You will say that fog bells and horns are an old story, and that they have not been particularly successful; but our scheme was of a somewhat different kind. In northern Japan, where fogs are the rule and not the exception which they are in England, and where changing currents of more than six knots are common off many dangerous parts of the coasts, ship-masters are very much in the habit of using their steam whistles, listening for the echo from the steep coasts, and judging from the interval of elapsed time what is their distance from the coast, and what is their position. But they find that on many foggy days they can, and on other foggy days they cannot use this method, because they may hear no echo, although quite near the coast. Now it seems to be forgotten by everybody that there is a medium of communication with a distant ship, namely, the water, which is not at all influenced by changes in the weather. At some twenty or thirty feet below the surface there is an almost perfect calm, although there may be large waves on the surface. Suppose a large water-siren like this (experiment shown)

FIG. 2.—SUBMARINE COAST WARNING.

An electro-magnet, with vibrating armature, giving out loud musical note.

is working at as great a depth as is available off a dangerous coast, the sound it gives out is transmitted so as to be heard at exceedingly great distances by an ear pressed against a strip of wood or metal dipping into the water. If the strip is connected with a much larger wooden or metallic surface in the water the sound is heard much more distinctly. Now the sides of a ship form a very large collecting surface, and at the distance of several miles from such a water-siren as might be constructed, we feel quite sure that, above the noise of engines and flapping sails, above the far more troublesome noise of waves striking the ship's side, the musical note of the distant siren would be heard, giving warning of a dangerous neighbourhood. I have

* Since the reading of this Paper my attention has been drawn to a letter in the *Engineer* of January 28th, 1876, from Mr. H. T. Humphreys, who there suggests the use of submarine sirens as coast warnings. Since the idea struck Mr. Ayrton and myself we have been wondering how it escaped attention so long. We now wonder why the lighthouse authorities have made no efforts in the last five years to carry Mr. Humphreys's idea into effect.

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no time now to tell you of the small experiments we have made in this direction. This electric bell sounds only very faintly when in water, and yet we have been able to hear it at a distance of sixty feet along a trough of water in a place filled with the noise of much heavy machinery. We took this water-siren to Hastings for a trial in ordinary boats, but the weather was too rough at the time for boats to go out, and, therefore, the experiment had to be postponed. We have constructed the arrangement shown full size in this diagram, in which currents of electricity are sent from a distance sufficiently rapidly intermittent through this electro-magnet to give the natural period of vibration to this armature when in water (Fig. 2). Whether this will prove successful or not we do not know, but we feel sure that the idea is to be carried out electrically, the source of sound being a motor worked by a generator on the nearest coast. In considering this problem, you must remember that Messrs. Colladon and Sturm heard distinctly the sound of a bell struck under water at the distance of nearly nine miles, the sound being communicated by the water of Lake Geneva.

(TO BE CONTINUED.)

GREAT NORTHERN TELEGRAPH COMPANY OF COPENHAGEN.

Abridged report of the annual general meeting, held at Copenhagen, on the 12th April, 1881.

F. ZAHLE ESQ., presided.

The chairman (C. F. TIETGEN, Esq.), after having in his introductory remarks referred to some points in the history, and congratulated the shareholders upon the present prosperous state of the Company, reported as follows upon the business generally:—Several of the European cables had suffered from interruptions, and unfortunately these had in some cases been of longer duration than ordinarily, owing mainly to stormy weather, which had prevented more speedy repairs. In the far East the cable between Shanghai and Amoy, although the most frequently interrupted, had not altogether been out of working order for more than twenty-six days during the year. The cables between Amoy and Hong Kong, and between Shanghai and Nagasaki had during the year been interrupted respectively for four and five days. There had been a marked increase in both the extra-European and the European traffic. The increase in the latter was mainly owing to the introduction of the word rate system adopted by the International Telegraph Conference held in London in 1879, and which took effect on the 1st April, 1880. As compared with 1879, the traffic returns for 1880 showed an increase of £28,000; on the other hand the expenditure had slightly increased. The directors had every reason to be satisfied with the decision arrived at that a new repairing steamer should be acquired. This vessel, which had been named the "Store Nordiske," although not ready for sea until September last, had already done good service and had proved herself fully equal to the Company's other steamer the "H. C. Œrsted" now stationed in China. The latter would return to Europe, and would in the course of this summer be replaced by the "Store Nordiske." Also, with regard to the laying of the English-Norwegian-Swedish cable, the shareholders could be congratulated. The cable had been laid from a point near Newcastle-upon-Tyne to Arendal in Norway, and from there to Marstrand, near Gothenburg in Sweden. The total length was about 522 nautical miles. It had been manufactured by the Telegraph Construction and Maintenance Company (Limited), and successfully laid by the same company in September last. It was opened for traffic on the 1st October last, and was now in the most perfect condition in every respect. During the six months it had been working it had proved, as was expected, a most valuable addition to the company's property, not only by contributing largely towards the acceleration of the transmission of the company's most important traffic, but also as a ready reserve in cases of interruptions of other cables and connecting land lines. There was another circumstance relating to the establishment of this new line which ought to be mentioned. The Swedish and Norwegian Governments, appreciating the acquisition of further outlets for their traffic, had agreed to extend the terms of all the existing concessions until the 1st January, 1911, and if it were considered that out of the Company's nine European cables six were landed in those countries, the prolongation of the Company's monopolies was of an importance which could not be overrated.

In accordance with the resolution passed at the extraordinary general meeting of the 17th November last, the capital required for the new cable had been obtained by the issue of £100,000 5 per cent. obligations, redeemable within twenty years. These had been offered to the public by Messrs. C. J. Hambro and Son, in London, and the Private Bank in Copenhagen, and had readily been taken up at par. In consequence of this measure the reserve fund had remained intact; £64,113 17s. 10s. had been further invested on account of that fund, and the interest on the investments would now suffice to meet the interest payable on the new loan.

The greatest event of the year for the Company had, however, been its connection with the extension of the telegraph system in China. At the request of the Chinese Government, the Company had, in July last, commenced a survey of the country between Shanghai and Tientsin with a view to the establishment of an overland telegraph service between those two places. On the completion of the survey a plan had been prepared by the Company for the construction of the line, and on the basis of this plan, which was approved by the Government, a contract had been entered into at Tientsin on the 22nd December last between the Government and the Company. According to this contract the Company would have to supply all materials, instruments, &c., required for the construction of the line and stations, and the Company had also agreed to appoint engineers to superintend the work, which would be commenced on the 15th May this year. The route of the line, which would be of a length of about 1,000 miles, would follow the Grand Canal, and great facilities would thus be offered for the transport of the materials and the subsequent maintenance of the line. Besides this the Company had undertaken to appoint the necessary teachers for a college of telegraphy which the Government had established at Tientsin. This line would be of the greatest importance for the development of telegraph undertakings in China, it would, no doubt, shortly be extended from Tientsin to Pekin, a distance of eighty miles, and thus connect this great capital and Tientsin, the commercial centre of North China, with the lines of the Company, and so with the whole world. The directors hoped, by loyally serving the telegraphic interests of the Chinese Government, to secure friendly relations with them, and so to obtain fair and profitable arrangements for the Company. As another event of the year, the directors would draw the attention of the shareholders to a contract entered into between the Imperial Russian Government and the Company, for supplying and laying a cable of about seventy nautical miles from the eastern coast of Siberia to the Island of Saghalien. The cable had already been manufactured in London, and would be sent out by the Company's ss., "Store Nordiske," in order to be laid by that ship during the most favourable season of the year. A short land line had been erected from the Company's station at Hong-Kong to the cable house, to supersede the wire which had hitherto been hung upon the Government posts. At the same time the Company had at the request of the Colonial Government, and for their account, laid a short cable from the Island to the Mainland.

The Company had hitherto only exceptionally exchanged telegrams directly with the public in London, as the position of their late offices was not adapted for the purpose. For several reasons the directors had now decided to establish the Company's own station, and had leased very convenient premises at No. 119, Bishopsgate-street Within, situated in the most central part of the City. The directors thought that by thus facilitating the direct acceptance and delivery of messages, they had consulted the convenience of the public, as well as the interests of the Company. The report was unanimously adopted without discussion, the accounts were passed, and discharge given to the board of directors. The retiring director, Colonel O. V. Hoskler, R.D.E., was re-elected, as also were the shareholders' auditors, His Excellency Admiral Bille, and A. Berner, Esq.

REUTER'S TELEGRAM COMPANY (LIMITED).

The 17th ordinary general meeting of the shareholders of this Company was held on the 27th inst. at the offices, Old-jewry, Colonel James Holland presiding.

The SECRETARY (Mr. F. J. Griffiths) read the notice convening the meeting, and the report of the Directors was taken as read. It stated, *inter alia*, that the net profits for the year ending the 31st December last, after payment of current charges and deducting bad debts and rebate on unexpired subscriptions, amounted to £8,278, including £108 brought forward. The usual interim dividend of 2½ per cent. was paid in October last, and the Directors now declared a further dividend of twelve shillings per share, equal to 7½ per cent., free of income-tax, making a total distribution of 10 per cent. for the year. This would absorb £7,366, and after adding £800 to the reserve fund there would remain a balance of £112 to be carried forward. The profit and loss account showed that the subscriptions, commission, &c., for the year had been £35,877.

The CHAIRMAN: Before moving that the report and balance sheet be read and adopted I wish to allude to two circumstances—one, that our meeting is about a month earlier than it has generally been held for some years past, and, owing to the impetus we have given to our agents in various quarters, we have great hopes that we shall be able to continue regularly the annual meetings at about the present time. The other matter I wish to allude to is that one of the members of the Board (Mr. Stopford) is unable to be present through illness, and requests me to apologise for his absence. With regard to the report, there are not many matters to explain in it. The main facts are that we are about £4,000 better on our gross profit than we were last year, and our expenses are also heavier, but not proportionately so, and we are, consequently, able to propose a 10 per cent. dividend for the year. The expenses have been unduly swollen by one or two matters over which we had no control. The first point is the Egyptian debt, which, at our last meeting, we had not realised. We have since then thought it prudent to sell the bonds the moment they came into our hands, and the sale, together with loss by exchange, and various expenses connected with it, amounted to about £600 of the total receipts. There are also sundry expenses connected with the expense of this freehold, to which I alluded at our last meeting. They are not likely to occur again. As to the balance sheet, the sundry creditors' and sundry debtors' accounts have all run off since the 1st of January last. The sundry debtors' account, instead of being £20,000 as last year, stands now at £13,000, in consequence of the payment of the Egyptian debt, which was before included among the debtors, and the account for the lease, which stood at £497, has been wiped off. We are now sitting as freeholders in our own property, and we believe that it will be found a very good purchase indeed. If there are any questions any gentleman would like to ask as to the details of the profit and loss account, and the appropriation of the balance, I shall be happy to answer them. I now propose, "That the report and balance sheet now presented be received and entered upon the minutes."

Admiral the Right Hon. Sir JOHN C. D. HAY, Bart., M.P., seconded the motion, and it was at once carried unanimously.

The CHAIRMAN then moved the re-election of the Baron de Reuter, and observed that it was perfectly unnecessary for him to say anything whatever upon the resolution beyond the fact that the shareholders would rejoice, no doubt, that the Baron had consented to sit for another term.

Admiral the Right Hon. Sir JOHN C. D. HAY, Bart., M.P., seconded the motion, and it was carried unanimously.

Baron de REUTER having expressed his thanks.

On the motion of Mr. Loveday, seconded by Mr. G. D. Williams, the auditors (Messrs. Quilter, Ball, Crosbie, Clegg, and Welton) were re-elected.

The CHAIRMAN then moved "That the shareholders of the Company do hereby approve of the establishment of an insurance and superannuation fund for the officers of the company, under the management and control of

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the directors, and with the view of making provision for that purpose the shareholders do hereby authorise the directors, out of the receipts of the Company, to apply from time to time such sum or sums as they shall think fit, not exceeding in the aggregate £300 per annum." The resolution, he felt sure, required very little to be said in support of it. Several of the telegraph companies—most of them in London, he believed—had either instituted a fund of this kind, or were on the eve of doing so, and it was one which commended itself to every man, not only of humanity but also of prudence, for nothing could be more judicious for any company than to attach its followers to it by substantial benefits, such as a plan of this kind held out. They proposed that on the death of any gentleman who had served them, and who had taken out a policy of insurance, a sum equal to one year's salary should be paid to his representatives.

Baron DE REUTER seconded the resolution, and it was carried unanimously.

On the motion of Mr. LOVEDAY, seconded by Mr. WILLIAMS, a cordial vote of thanks was passed to the chairman, directors, and managing director (Mr. Herbert de Reuter).

The CHAIRMAN expressed the acknowledgments of his colleagues and himself, and hoped that they might meet next year under similarly favourable circumstances.

The proceedings then terminated.

INDO-EUROPEAN TELEGRAPH COMPANY (LIMITED).

The fourteenth ordinary general meeting of this Company was held on the 28th instant, at the New Exchange-buildings, George-yard, Lombard-street, under the presidency of Colonel James Hoiland.

The MANAGING DIRECTOR (Mr. W. Andrews) read the notice convening the meeting, and the Chairman affixed the common seal of the Company to the register of members. The report was taken as read. It stated, *inter alia*, that the Company's revenue, from all sources, for 1880, amounted to £98,731, showing an increase of £12,372. The expenses were £46,463, showing an increase of £672. After charging £10,169 percentage upon profits payable to Messrs. Siemens under their maintenance contract, taking credit for the balance brought over from last year, £748, and deducting income-tax, there remained the sum of £42,362. From this amount the interim dividend of £10,625 already paid had to be deducted, leaving a net balance of £31,737 to be dealt with. The directors proposed to declare a dividend for the last six months of 17s. 6d. per share, making, with the interim dividend already paid, 6 per cent. for the year, and a bonus of 10s. per share, both free of income-tax. Out of the balance of £8,362, £7,500 is proposed to be added to the reserve fund, and £862 to be carried to the credit of the current year. The Company was still pressing its claim against the Russian Government.

The CHAIRMAN moved the receipt and adoption of the report and accounts, but before putting it, stated that he should like to make a few observations first. The report was short, and he believed it was generally found that when the affairs of a company were reasonably prosperous, reports were short in proportion, for there was very little to explain, and certainly nothing on the present occasion of an unpleasant nature. The main facts were that they had had an increase in the gross receipts of about £12,000, which had been earned at an outlay of £600. He thought they would admit that that was very satisfactory. The particulars of the various expenses noted in the revenue account were in his hand, and any detail which any gentleman required to ask for he would be happy to give. As to the items of sundry creditors and sundry debtors—respectively £12,975 and £30,896—he might say that the whole of these had run off. They were running accounts, in fact, which they kept on both sides. They had to pay certain sums to various companies and constituents and to receive other sums from other companies and other constituents. The accounts showed what those items were on the 1st of January last. A few minutes before the meeting he was examining the list of unsettled accounts for the past month, and he found only one, of about £700, which was due by the Secretary of State for India; and therefore he hoped they would consider that they were pretty well posted up, and that there was not much cause for fear in that quarter. They had not, as far as he knew, and as far as Mr. Andrews knew, a single bad debt. By the articles of association of the Company, before recommending a dividend the directors were empowered to set aside such sum as in their discretion they thought fit for the reserve fund, and they had on that occasion set aside £7,500. Considering the large profits they had made, and the absolute necessity and expediency in every sense of having a sound and substantial reserve fund, he felt very little doubt that they would concur with the action of the board in this particular. The relations with their customers, and the other companies with whom they had business transactions, continued to be cordial, and he had every reason to hope and believe that they would continue so. Two other matters were mentioned in the report: the establishment of an insurance or endowment fund, as to which he would move a resolution afterwards, and the appointment of Mr. Andrews as managing director [applause]. As regarded the Company, it was little more than a compliment to that gentleman, showing the esteem in which they held him, but it placed him in a better position as to other companies and other Governments with whom he was associated that he should have that designation. They felt too that it was only right that they should do all they could to improve Mr. Andrews's position. They had felt it their duty to communicate to the Governments of Germany and Russia the change made in the position of Mr. Andrews, and he should read the replies of the representatives of these Governments as showing what they felt respecting that gentleman. After an official reply from the Imperial German Telegraph Administration, the present Minister of Posts and Telegraphs, his Excellency, Dr. Stephan, wrote to Mr. Andrews the following letter:—

"I have been informed that the Board of the Indo-European Telegraph Company have appointed you managing director. Permit me to express to you my best congratulations upon this event. Since I had the pleasure of making your personal acquaintance at St. Petersburg in 1875, the judicious and intelligent conferences then enjoyed with you, upon administrative and tariff questions embraced in the subject of telegraphy, have always been a pleasant remembrance to me. I am convinced that the choice of the board could not have fallen upon a more competent and worthy gentleman, and I congratulate the Company upon their having you at their head as managing director.

"Accept the expression of my particularly high esteem.

(Signed) "DR. STEPHAN."

"Berlin, 8th April, 1881."

The following letter had also been received from His Excellency General Von Lueders, the Director-General of the Imperial Russian Telegraphs:—

"I have received your communication of 31st March, Sub. No. 2,686, and I am much pleased that your services in the skilful management of the Company's business, and in the maintenance of the Company's interests, have been acknowledged by your appointment to the managing directorship.

"At the same time I beg to send you my sincere congratulations upon this promotion, and hope that the good relations hitherto existing with my Government will continue unaltered.

"I take this opportunity to assure you of my continued high esteem.

(Signed) "V. LUEDERS."

"Dated St. Petersburg, 31st March (12th April), 1881."

He concluded by moving the resolution.

Mr. W. H. BARLOW having seconded the motion,

Mr. HOELZER thought that the amount proposed to be contributed to the insurance or endowment fund was too much at present.

The Hon. ROBERT GRIMSTON expressed great satisfaction with the report and position of the Company, and commended the action of the directors in making constant additions to the reserve fund. By this provision the Company was placed in a stronger position, with the result that the property of the shareholders was becoming more valuable every half year. He, however, thought, as they were to receive what was equal to a dividend of 8 per cent. that it should be stated boldly.

The CHAIRMAN replied, and said it was felt to be more judicious to make the distribution as dividend and bonus.

The report was then unanimously adopted, the dividend and bonus were declared, a resolution for establishing the insurance or endowment fund was passed, the sum to be contributed to it not to exceed £1,000 a year, and the retiring directors and auditors were re-elected.

A hearty vote of thanks to the Chairman and Directors terminated the proceedings.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices April 27.		Business Done Week Ending April 27. Highest.	Lowest.
Anglo-American	57¼,	58	58¼	57¼
Do. Preferred	88¼,	¾	88	86¼
Do. Deferred	30½,	31	30¾	30
Brazil Submarine	10¼,	⅜	10¼	10¼
Cuba	9,	¼	9⅛	9⅛
Do. Preference	16½,	17	—	—
Direct Spanish	3¼,	4¼	—	—
Do. Preference	13,	14	13½	13
Direct United States Cable	11⅛,	¼	11¼	11⅛
Eastern Telegraph	9 13-16,	15-16	10¼	9½
Do. 6 per Cent. Preference	12½,	¼	13	12½
Do. 5 per Cent. Debentures, 1899	102,	104	—	—
Eastern Extension	10 15-16,	11 1-16	11	10¾
German Union	11¼,	¼	11¼	11⅛
Globe Telegraph and Trust Company.	6¼,	¼	6¼	6 11-16
Do. Preference	12¼,	¼	12¼	12¼
Great Northern	12¾,	13	13	12¾
Indo-European	28½,	29½	—	—
Mediterranean Extension	2¼,	⅜	2⅜	2⅜
Do. Preference	9½,	10¼	—	—
Reuter's	11,	12	—	—
Submarine	270,	290	285	285
West India and Panama	2¼,	¼	2 5-16	2
Do. 1st Preference	7,	¼	—	—
Western Brazilian	8¼,	⅛	8 7-16	8 7-16
West. Union 7 per Cent. 1st Mortgage	124,	129	127	127
Do. 6 per Cent. Sterling Bonds	104,	108	—	—

TRAFFIC RECEIPTS FOR MARCH, 1881.

Companies.	March, 1881.	March, 1880.	Incrse.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	3,100 estd.	3,586	—	486
Direct Spanish Telegraph Company	1,492	—	—	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	51,206	43,374	7,832	—
Eastern Extension Telegraph Company	29,661	26,425	3,236	—
Great Northern Telegraph Company	18,520	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

SUBMARINE CABLES TRUST.—NOTICE is hereby given that the TENTH ORDINARY ANNUAL MEETING of the CERTIFICATE HOLDERS of the Submarine Cables Trust will be held at the offices of the Trust, No. 66, Old Broad-street, in the City of London, on TUESDAY, 3rd day of May, 1881, at 2 o'clock in the afternoon, on the general business of the Trust, and for the purpose of receiving and considering a report of the Trustees.

A Trust Certificate must be produced by each person attending the meeting.

By order of the Trustees,

LEWIS WELLS, Secretary.

66, Old Broad-street, E.C., London, April 25, 1881.

WANTED, ELECTRICAL INSTRUMENT MAKER. Experienced and Industrious Man as Foreman, will be liberally dealt with. Railway fare returned after one month's service. Apply (enclosing photograph, testimonials, and particulars of capabilities, and present wages) to ANDERSON and MUNRO, Glasgow.

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THE CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
French Government	ss Ampère	—	—	——	——
Telegraph Construction	ss Calabria	3,325	300	H. Manning	Natal.
Henley's	ss Caroline	526	70	——	North Woolwich.
French Government	ss Charente	—	—	M. Dufour	——
Eastern	ss Chiltern	1,304	200	W. Goodsall	Malta.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	P. M. Hayward	Havana.
Siemens'	ss Faraday	4,908	500	H. T. Maypee	Woolwich.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	W. F. Wardroper	New Orleans.
Eastern	ss John Pender	1,213	98	W. Perkins	Bombay.
Telegraph Construction	ss Kangaroo	1,773	160	J. Seymour	Rio de Janeiro.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Canadian Government	ss Newfield	785	90	R. A. Guildford	Canada.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Great Northern Telegraph Company of Copenhagen	ss H. C. Oersted	580	120	G. Oersted	China and Japan.
Paris and New York	ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Malta.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	——
Telegraph Construction	twin screw Scotia	4,667	550	W. R. Cato	Atlantic
Telegraph Construction	ss Seine	3,579	500	A. Kellett	Victoria Docks.
Eastern Extension	tw screw S. Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	——	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.
Great Northern Telegraph Company of Copenhagen	ss Store Nordiske	832	120	Einar Suenson	North Sea & Baltic.
International Ocean Telegraph Company of America	tw sc Prof. Morse	900	—	——	Key West, U.S.
West India Telegraph Company	Duch. of Marlboro'	402	—	——	——

ABSTRACTS OF SPECIFICATIONS.

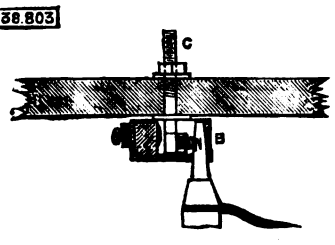
3670. An Improved Process of Regenerating the Fluids of Galvanic Batteries, in which Caustic Alkalies are Employed, and of Recovering the Zinc Hydrate from Solution, *A. M. Clark.*—*Dated 9th September*, 1880.—(*A communication from E. Reynier.*) 4*d*.

The process is as follows:—The inventor separates by decantation the insoluble carbonate of zinc, which may have been formed by the carbonic acid of the air, or by any carbonates that may accidently be present with the caustic alkalies; he then adds to the liquid left four to eight volumes of water, which precipitates the zinc hydrate, then decants, collects the zinc hydrate, washes thoroughly, drains and dries it; he next evaporates the dilute lye which has been drawn off, concentrating it till it attains its original density, and finally eliminates any carbonic acid the liquid may still contain by caustification with lime.

238,803. Switch for Telephone Exchanges, *Augustus H. Palmer, Utica, N.Y.*—*Filed June 28th*, 1880.

Brief.—A modified form of spring jack, the moving parts being enclosed in a circular case. The plug has the conducting cord entering the handle laterally and secured with a nut and washers. *Claim.*—(1) The combination of the perforated case B and pin with the pivotted dog G and male and female screws, arranged in the manner and for the purpose set forth. (2) The jack or dog G, provided with the arms or lugs and

238.803

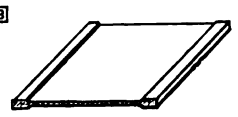


arm and contact points, in combination with a plug or plugs, whereby the ground is cut off and an electric circuit established, as set forth. (3) The pin or plug constructed as described, in combination with washers, nut, and wire, whereby the wire is admitted through the side of the plug handle, and a simple and reliable connection made.

238,868. Manufacture of Carbons for Incandescent Electric Lamps, *Thomas A. Edison, Menlo Park, N.J.*—*Filed May 24th*, 1880.

Claim.—(1) The method of forming carbons for electric lamps, which consists in shaping a block of wood as described, then cutting, splitting, or shaving into straight pieces, adapted for simple carbons, then bending such pieces into the desired

238.868

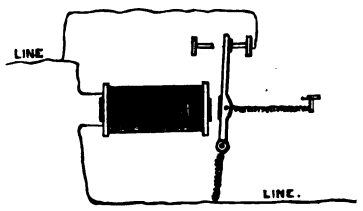


form and carbonising in such form, substantially as described. (2) The block for the manufacture of carbons for electric lamps, consisting of the central web and thickened or broadened ends, substantially as described.

238,912. Shunt for Speaking Telephone Systems, *Francis W. Jones, Chicago, Ill.*—*Filed August 25th*, 1880.

Claim.—The combination, substantially as herinbefore set forth, of an electro-magnet, armature, armature lever, and contact stops with a main line in which said electro-magnet is included,

238.912

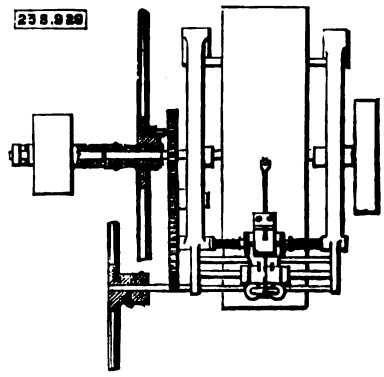


a circuit-connection between the back contact stop and a point in the main line on one side of the electro-magnet, a circuit connection between the armature lever and a point on the opposite side of the electro-magnet, and an artificial resistance included in one of said circuit connections.

238,929. Automatic Telegraph, *William A. Leggo, New York, N.Y., assignor to Electro Graphic Manufacturing Company, same place.*—*Filed November 30th*, 1880.

Brief.—A device for preparing and transmitting messages automatically. The message is placed upon a revolving metallic cylinder in non-conducting ink while revolving at a comparatively slow rate of speed. By a clutch a rapid-rate gear is thrown into connection with said cylinder, so as to transmit the message at a high speed through the agency of a metal stylus, which makes electrical contact through the cylinder to line. The cylinder is inked by a pen controlled by an electro-magnet and key. *Claim.*—(1) The method of automatic transmission herein described, which consists in causing the ordinary manipulations of a key to be recorded in insu-

238.929



lating and conducting spaces upon a suitable surface, and then using the record so made to automatically control the transmitting circuit, substantially as set forth. (2) The combination, with one transmitting surface, of two sets of gearing, one adapted to give the surface a much greater speed of movement than the other, and means for changing from one to the other, substantially as set forth. (3) The combination, in an apparatus for preparing messages for telegraphic transmission, of a conducting surface, a pen adapted to normally ink the surface thereof, and devices arranged to lift the pen from the surface when it is desired to indicate thereon signals for transmission, substantially as set forth.

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By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

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Of which paid up	300,000
Fire Reserve Funds	637,977
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SLIP

CABLE REPAIRED.—The cable between Jamaica and Colon is repaired.

SHETLAND ISLANDS.—The cable between the Orkney Islands and the Shetlands is interrupted.

TUNIS.—Telegraphic communication, which we noticed as interrupted a few days ago, is now restored.

ELECTRIC LIGHT IN MELBOURNE.—The electric light is to be tried in the Melbourne Parliament Houses.

BRUSSELS AND THE LIGHT.—A trial of the electric light is shortly to be made in the Chambre des Représentants, in Brussels.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—The next meeting of this society is fixed for the 12th instant.

ELECTRIC LIGHT IN PARIS.—We learn that it is in contemplation to adopt the electric light in the chief post office and principal receiving houses at Paris in place of gas.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY.—The twelfth distribution on the Second Bonus Trust Certificates at the rate of 2s. 6d. per £5 certificate is announced.

ROYAL UNITED SERVICE INSTITUTION.—Last night a paper was read before this institution by Captain J. T. Bucknill, R.E., on the "Protection of Buildings from Lightning."

THE TELEPHONE IN AMERICA.—Telephone exchanges are being established in Chelsea, Malden, and Everett (Massachusetts). They will be connected with each other, and with Boston.

WEST INDIES.—The cable between Key West (Florida) and Havana is interrupted. Delay will consequently occur in the transmission of all telegrams to the West Indies, Colon, &c.

DIRECT SPANISH TELEGRAPH COMPANY.—The traffic receipts of this company for the month of April, 1881, amounted to £1,337, as against £1,453 in the corresponding period of last year.

A NEW KIND OF LUNACY.—A lunatic confined in a Philadelphia asylum imagines he is a telephone. He is continually answering calls and receiving imaginary messages from all parts of the world.

ROYAL SOCIETY.—On Thursday evening, the 5th May, a paper was presented by Lord Rayleigh, F.R.S., and Dr. Schuster, F.R.S., "On the Determination of the Ohm in Absolute Measure."

QUITE SO!

Like lightning rods, sweet girls should be,
Cool, pointed, straight, exacting;
Drawing the sparks—yet not too free,
Nor harmed by their attracting.

WISE PEOPLE.—*La Lumière Electrique* says that since the fire at the Nice Theatre, several municipal councillors of various towns of France have insisted on the installation of the electric light, and the telephone, in theatres and other large public buildings of their towns.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED). Notice is given that the board have resolved upon the payment of an interim dividend of 5s. per share, being at the rate of 5 per cent. per annum for the quarter ended 31st March, such dividend to be payable on and after the 16th May.

JAMAICA.—A land line is to be constructed between Kingston and Port Royal in preference to a submarine cable. The fair sex would seem to be making their mark even in this out-of-the-way part of the world, as the *Colonies and India* says that thirty-five of them are employed in the local telegraph service.

THE CUBA SUBMARINE TELEGRAPH COMPANY.—The number of messages passing over the lines of this company during the month of April was 3,047, estimated to produce £3,100, against 2,711 messages, producing £3,139 in the corresponding month of last year. The traffic receipts for the month of February, estimated at £2,900, realised £2,867.

ELECTRIC LIGHT AT AKRON, OHIO.—A square mile of Akron is lighted by electric lights. The lights are located on an iron tower at the corner of Howard and Market streets, 208 feet high, and on the steeple of Bechtel College, 146 feet high. There are four lamps on each tower of 1,600 candle-power each. The entire cost of the outfit is about 8,000 dollars.

PRICES.—The prices as quoted are:—For gutta percha, per lb., genuine 4d. to 3s. 3d., reboiled 3d. to 1s. 3d.; for india rubber, per lb., Para, fine, 3s. 6d., negrohead 2s. 5d., central American 1s. 11d. to 2s. 6d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d. Para, fine, is reported as firmer, but other kinds quiet.

TELEGRAPH MATERIALS WANTED.—Tenders are invited for the supply of 150 tons galvanised annealed telegraph wire, 150,000 galvanised iron brackets, 300,000 galvanised wood screws, and 175,000 porcelain insulators. Particulars from La Direction du Materiel et de la Construction, Ministère des Postes et Télégraphes, rue de Grenelle, St. Germain, 103, Paris, where tenders will be received up to the 9th May.

A NEW TELEPHONIC EXPERIMENT.—The Paris correspondent of the *Daily Telegraph* reports that an interesting experiment has just been made between Calais and Dover with a new kind of telephone, patented under the name of the "Electrophone." The articulation is said to have been perfect, and there was no perceptible interference through the companion wires in the same cable, which were working hard all the time.

TELEPHONE CONVENTION.—The semi-annual convention of the National Telephone Exchange Association, formed last September at Niagara Falls, for the purpose of collecting, preserving, and protecting all matters of importance to telephone interests, was held in Chicago on Tuesday and Wednesday the 5th and 6th of April last. Discussions on various subjects, notably on the insulation of telephone wires, took place, and the convention then adjourned till next September.

JAY GOULD.—We believe that negotiations between Jay Gould and the existing Atlantic Cable Companies are for the moment suspended, because he seeks to impose terms which it is absolutely impossible to accept. It is possible that Jay Gould looks more to Stock Exchange transactions for his return than to the profits in business transacted through a new cable; but we may remind him that ere now others have burned their fingers in the pursuit of chimeras, and he may do the same.

THE LONGITUDE OF PARIS AND BESANCON.—The Bureau des Longitudes has decided that it is necessary to establish the difference of longitude between these two places. M. Loewy's electric method will be made use of in the calculation. It has already been employed for calculating the longitudes of Marseilles, Alger, Bona, Neufchatel, and Vienna. This operation is important, owing to the project that is on

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foot to establish a chronometric observatory at Besancon, which is the centre of the French clock industry.

CONTACT OF METALS AND GASES.—Herr Schulze-Berge, of Berlin, finds that ozone makes gold, platinum, and brass negative to a plate of the same metal in air. Hydrogen always makes platinum strongly positive, while its influence on gold is hardly perceptible, and on brass is qualitatively various. Chlorine makes platinum negative ; ammoniacal gas (from aqueous solution) makes brass positive. The professor uses a condenser with two circular plates of a given metal, the upper plate being connected with an electrometer and submitted to the contact of the gases, the lower connected to earth.—*Wiedemann's Annalen.*

ELECTRO-DYNANOMETER.—In our description of this instrument on April 2nd and 16th, we should have stated that the illustrations on p. 246 are from photographs specially taken from the completed instrument for us, and vary (as will be seen on examination) only in a few details from those on pp. 281-2, which are reproductions on a small scale of the working drawings supplied with the order, and which were, we believe, made by Professor W. N. Hill, of the United States Torpedo Station, to whom the entire credit of design and construction are due. We regret that by an oversight no definite mention was made of Professor Hill's work when the descriptions were published.

THE CONDUCTIVITY OF CARBON.—Dr. W. Siemens finds that raising the temperature of carbon rods causes the resistance to diminish from 1·452 at 20 C. to 1·375 at the temperature of molten tin, and 1·298 at the temperature of molten zinc. Cooling, however, causes the resistance to increase to 1·685, when the temperature has cooled down to 20 C. The rods experimented on were of different thicknesses and lengths, the ends electrotyped with copper and leading wires attached. For low temperature the carbon was heated in a bath of melted paraffin, and for high temperature it was placed in a copper tube, the ends being closed with plaster of Paris plugs, the tube being placed in an open fire brick oven. —*Ann. der Phys. u. Chem.*

ELECTRIC LIGHT AT HAMILTON (CANADA).—A Mr. J. L. Wilson, of Hamilton, recently exhibited his apparatus for lighting by electricity. The motive power is an engine of two horse-power. The burner is made of coke and molasses, the parts being held in position by a clockwork attachment, which works automatically. The generator is said to be about one-fifth the weight, and can be manufactured at much less cost than any electric machine in New York. The light, including carbons, which consume at the rate of $1\frac{1}{2}$ inch per hour, and power from the engine, costs about 2 cents per hour, one light being sufficient to illuminate one large-sized floor of a warehouse. A company is about being formed to work Mr. Wilson's patent.

THE NOISES MADE BY THE VOLTAIC ARC.—M. A. Niaudet finds that the noises made by the voltaic arc occur when there is a diminution in the potential of the two carbons. This variation in potential corresponds in inverse manner to the intensity of the current. The results, as obtained by M. Niaudet with a Deprez galvanometer for measuring the intensities and E.M.F.'s, are given below :—

Intensity of current in Weber's.	Difference of Potential.	
34	54,3	Silence
36	43	Noise
34	49	Silence
43	41,4	Noise
38,1	49	Silence

ATMOSPHERIC ELECTRICITY AND THE VINE.—The influence of atmospheric electricity on the vegetation of the vine has been studied near Palermo by M. Macagno thus :—Sixteen stocks were rendered more subject to the effects of the electric current by means of a copper wire inserted vertically, with platinum point in the upper end of the fruit branch, while another wire connected the bottom of the branch with the ground. This continued from April to September. An acceleration of vegetation was proved by the wood of these stocks containing less mineral matters and potash than that of the other stocks, while the contrary occurred in the leaves, and in these the potash was mostly in the bitartrate form. A much greater quantity of must was got from the grapes of those vines, and it had considerably more glucose and less acid.—*Nature.*

TANTALUS.—

When lovely Mary speaks to me,
  And sets my foolish heart a-thrilling,
Life has no gift I would so prize
  As just to look in those clear eyes ;
  And she—I think she would be willing.
Her kindly speech, her pleasant ways,
  Fill all my days with sunny weather ;
To hold her hand in mine, to share
The faint, shy fragrance of her hair—
  Earth would be Eden altogether !
Alas ! we work by telegraph,
  I and this dainty, far-off Venus,
And when we hold a *tête-à-tête*
We have—Oh, irony of Fate !—
  Two hundred miles of wire between us !

—*Operator.*

VOLTAIC CONDUCTIVITY OF HEATED GASES.—In a memoir recently presented to the Academy by M. Blondlot, he shows, as the result of careful experiments, that, contrary to M. Wiedemann's opinion, and in conformity with that of M. E. Becquerel, heated gases will conduct a current from five Bunsen cells, not only when they are at a red heat, but even at a temperature of 60 degrees to 70 degrees. In every case the agitation of the gas, or interposition of a screen, put an end to the phenomenon. If the platinum plates used as electrodes are heated to different degrees, they give a considerable E.M.F., and the warmest plate constitutes the negative pole ; this phenomenon is of the same order as that observed by M. Becquerel in the flame itself. The experiments were made with a distance of two to three centimetres between the electrodes.—*La Lumière Electrique.*

THE ELECTRIC LIGHT AT BARCELONA.—Experiments are now being conducted by Messrs. Dalman with the object of illuminating one of the quays of the harbour by means of the electric light. Five lamps have been fixed on the top of poles from 18 to 30 feet high, and at varying distances from each other. The current is obtained from a Gramme machine situated 400 yards from the scene of the experiments, and the earth is substituted for the usual return wire. The electric light has been successfully employed at an exhibition of pictures held in the large hall belonging to the Ateneo Barcelonès. Three Siemens lamps were used, and the light was reflected from a white awning suspended from the dome of the hall. Messrs. Dalman have the intention of fitting a central station with the necessary machinery, and of supplying electrical power to any point of Barcelona within a certain radius.

AN IMPROVED AIR PUMP.—*Nature,* quoting from *Wiedemann's Annalen,* No. 3, says that an improved form of the Töpler air-pump has been devised by Herr Bessel-Hagen, with which considerably higher vacua can be obtained than those Mr. Crookes obtains with the more complicated and fragile Sprengel-Gimingham apparatus. The average limit of rarefaction was found to be 1-63 millionths of an atmos-

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phere (1-95th in one case), while the other pump only gives 1-17 millionth. (It is noted that Professor Ogden Rood has obtained 1-94th, and in one case even 1-110th with a modified Sprengel.) With his highest vacua the author found electricity to pass (using plate-electrodes and a strong Holtz machine, with Leyden jars). He considers mercury vapour an insulator for electricity; but shows that radiometric movements depend greatly on its pressure *in vacuo*. No diffusion of hydrogen through the glass could be detected.

Edison Electric Light Company.—A telegram from New York says "that the mayor's veto, forbidding the laying down of wires for the electric light by this company has been overruled by the aldermen. The company will now proceed to introduce its incandescent lamps in the offices round Wall-street. Each lamp is to be of 16 candle-power. Wires have already been put into forty houses. The company are going to charge the same rates as the gas company, and are prepared, should the latter reduce, to do the same." Later intelligence says "that the Commissioners on Street Lighting have given contracts for another year to the gas companies. They say they would have given a contract to light Broadway and the Fifth Avenue to the Brush Electric Company had it not been for the mayor's veto forbidding the company to lay pipes and tubes in the streets. The Brush Company has been lighting a portion of Broadway for several months at its own expense."

"The Boston Telegram."—Such is the title of a new American contemporary. The *Operator*, which questions our ability to understand the jokes of its editor, must look to its laurels, or this new rival will surely oust it from the proud position it has hitherto claimed as the only successful paper of its kind. Of our new contemporary, we may say that its tales are queer, and its illustrations quaint. If future numbers are as good as the one before us, the paper ought to wile away many an hour when, with heels raised and back horizontal, an aureole of blue smoke hangs around the edges of the sheet, and envelops the face of the reader. Of its science we cannot say that it is

> Terrible and loud
> As the strong voice that from the thunder cloud
> Speaks to the startled midnight.

Nor can its poems compare with those of Coleridge, yet they will doubtless amuse, as 'tis their purpose to. The editor is Mr. Joseph Nash.

Experiments on Polar Attraction.—Herr Holtz has made an instrument showing polar effects in the way of attraction and direction. He cements a plane piece of glass to one end of a short glass rod, and to this again a short narrow tube (in a line with the rod). In the tube is placed a sewing needle longer than it, and carrying at its head a thin pasteboard disc (22mm. across), which has attached on one half of its periphery, reaching over both above and below, a pasteboard strip (10mm. broad); opposite this, on one of the surfaces, is fastened a small projecting point of tinfoil. Brought between hollow discs fixed to the rods of a Holtz machine, the tinfoil point always turned to the positive pole. Next, the glass rod with its disc was attached to the end of a light horizontal glass tube, hung bifilarly, and so brought between the hollow discs. The disc first turned into position, and was then attracted towards the negative pole. The phenomena are thought to illustrate unipolar conductivity.—*Wied. Ann.*

Electric Lighting in the City.—The trial of the "Lontin" light was to have commenced on Monday last, the 2nd May, but the Electric Light and Power Generator Company have asked for and obtained an extension of time to the 1st June. The district set apart for this section of the experiment comprises Southwark Bridge, Queen Victoria-street, Queen-street (between Queen Victoria-street and Upper Thames-street), and Queen-street-place. Thirty-four electric lamps are to be substituted for 165 gas lamps (costing annually, including lighting and cleaning, £713). The amount of the contract for 12 months is £2,930, but, eliminating the sum of £1,500 estimated for providing and fixing the electric machinery and lamps, and removing the same at the expiration of the contract, the cost is a little more than twice that of gas. Owing to a defect in insulation the Brush system broke down the other night, all the lamps going out. The fault was soon repaired, however, and we have no doubt everything will go on smoothly again.

Legal.—At Toronto, Ont., on the 5th April last, judgment was delivered in the case of the U.S. Direct Cable Company *v.* the Dominion Telegraph Company. The facts are as follow:—Pursuant to an agreement between the two companies, certain matters in dispute between them were to be referred to arbitration. The Dominion Company appointed Mr. Sampson as their arbitrator, and the Cable Company appointed by cablegram Mr. Da Costa as theirs. The latter wanted to get a copy of the submission, and applied for it. The umpire had to be appointed within ten days, and the Dominion Company appointed another arbitrator named Buckley, and he and Sampson appointed the umpire. The Cable Company then took proceedings in a New York court to restrain the arbitrators. After argument, the Court decided that they had no jurisdiction, when an application was made for an injunction before Vice-Chancellor Blake at Toronto. The latter has decided that the declaration asked for by the Cable Company should be granted, and that the Dominion Company must pay the costs, also the costs of Sampson and Buckley, who were made co-respondents.

Improvements in Cowper's Writing Telegraph.—Herr Max Jüllich, of the Polytechnic at Vienna, has discovered that he can dispense with the two-wire arrangement usually adopted, and use but one. He noticed that currents of rapid intermittency caused a galvanometer needle to deviate to a fixed point and without oscillation, at the same time that these deviations were not so great as those produced by constant currents of the same intensity. He therefore constructed two discs similar to the distributing discs of Meyer's quadruplex system. These two discs are made to move synchronously by means of clockwork, the one to the transmitting post, the other to the receiving post. At short intervals, these two distributors connect the line wire alternately with each of the galvanometers of the Cowper receiving apparatus. At the same time the line is connected successively with each of the rheostats of the transmitter. The power of the current on each distributor is regulated by means of a spring furnished with a conical contact. The synchronism of the two discs is maintained, almost in the same manner as in the Hughes instrument, by transmitting a correcting current which is shut off once every turn.—*Electrotechnische Zeitschrift.*

Telephoning Extraordinary.—At the third popular evening of the session of the Glasgow Photographic Association, at the Commercial Hall, Argyle-street, amongst other articles of scientific interest exhibited was a telephone, lent for the occasion by Messrs. D. and G. Graham, the telegraph engineers, which was placed in communication first with their Telephone Exchange in Sauchiehall-street, and subsequently with the residence of Mr. David Bannerman at Langside, a total distance of about four miles. At both these places, such was the extraordinary sensitiveness of the instrument,

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the songs, music, applause, and other sounds incidental to a concert, even to an occasional cough and laugh, were most distinctly audible, notwithstanding the fact that the telephone was fixed as far from the platform as the shape of the hall would permit. It was noticed that the tenor and soprano songs were heard with special distinctness, a duet, "Juanita," sung by Misses Brodie and Dykes; Arditi's "Stirrup Song," by Mr. M'Lagan; and Offenbach's "Lady, look down," by Mr. Rhind, being particularly noteworthy. So well, indeed, was the music rendered that on several occasions the distant auditors, at the termination of a piece, involuntarily joined in the applause.

THE TORPEDO ACCIDENT AT MELBOURNE.—Particulars of the terrible torpedo accident which occurred during the shot and shell practice of the turret-ship "Cerberus" are to hand. It appears the day's work was nearly got through when Groves, who was a gunner in the Royal Navy, and who had been lent by the Home Government to the "Cerberus" for the purposes of torpedo instruction, undertook to fire the torpedo. He procured from a magazine a zinc case, containing 70lbs. of powder. The torpedo was to be fired from the ship by electric current. Groves then, with five seamen for a boat's crew, started from the ship, the Hooper's core wire, which was attached to the torpedo, being paid out as the boat rowed off. As the torpedo was being lowered from the boat into the water, one of the oars fouled the wire; and as Groves, with two assistants, was freeing it, the thing exploded, blowing the boat and all in it to a great height in the air, with an immense column of water. The bodies of three of the men could not be discovered, being blown to atoms, that of Groves was picked up with the head blown off. One man only was saved, and he would certainly have been drowned had not Mr. Houston jumped overboard from the "Cerberus" and saved him.

INTENSITY OF THE LIGHT FROM INCANDESCENT PLATINUM.—On the 27th January, 1879, M. Violle presented a memoir to the French Academy in which he dealt with the intensity of the red light emitted by incandescent platinum at different temperatures, from 900 to 1,775 degrees, the result of his investigations tending to show that the intensity I, taking as unity a platinum cell at 954° (the temperature at which silver melts), could be represented at the temperature t by the formula

$$\text{Log. } I = 8{\cdot}244929 + 0{\cdot}011475\ t - 0{\cdot}000002969\ t^2,$$

which gives as the value of the luminous intensity :—

Deg.		Deg.	
At 800	0·108	At 1,400	100
,, 900	0·475	,, 1,500	194
,, 1,000	1·82	,, 1,600	327
,, 1,100	6·10	,, 1,700	481
,, 1,200	17·8	,, 1,775	587
,, 1,300	45·2		

In a recent note M. Violle adds to his previous communication the value of the luminous intensities of the different simple radiations given out by the incandescent platinum, taking as units of comparison the temperatures, 954°, 1,045°, and 1,500°. He gives the following figures for the radiations C and D, in which λ was equal to 656 and 589·2 :—

Degrees.								
775	0·19	—	—	0·05	—	—		
954	1	—	—	1	—	—		
1,045	3·27	1	—	3·64	1	—		
1 500	154	47	1	219	60	1		
1,775	507	155	3·30	809	322	3·70		

THE DANGERS OF CRITICISM.—Our obtuseness is rebuked, and for the future we will take American humour as perfect. Cousin Jonathan, we cry "*Peccavi!*" "About four years ago this journal (the *Operator*) published a brief account, written by 'Werner,' of a West Philadelphia superintendent being struck by lightning, of the bolt having taken him squarely on the head, knocking him down, and of his subsequently explaining apologetically that he had been sick for two weeks else he would not have displayed so much weakness. It was an English journal that copied that paragraph in all earnestness, characterising it as 'wonderful tenacity of life.' This may explain why our esteemed scientific contemporary, *The Electrician*, in reviewing 'Tales and History,' is lost in Cimmerian darkness with regard to the humour therein; and, while our able contemporary is good enough to acknowledge much merit in the work, it cannot refrain from observing, in its own Addisonian style, that 'we stolid Britains are sometimes inclined to wonder at the ease with which our cousins allow themselves to be amused.' We have a great deal of respect generally for the flag that has braved a thousand years the battle and the breeze, and much admiration for the enterprise and tact displayed by *The Electrician* in particular, but when it comes down to appreciating the fine point of a random joke we must say that it requires a copious supply of explanatory foot-notes to satisfy our jolly cousins. To aid in a better appreciation of the work we reprint to-day two intelligent opinions of the 'funny' part of 'Tales and History,' one from the New York *Sun*, representing the most critical and widely-circulated daily paper on this continent, and the other from the London *Design and Work*, representing the brains of England [*chacun à son goût*—ED. *E.*], or as little of it as is not engaged in editing *The Electrician*." *(Sic itur ad astra.)*

NOTE ON AN ELECTRIC SONOMETER. By PROFESSOR JAMES BLYTH.—The apparatus consists of an ordinary sonometer with five feet clear space between the two end bridges, and having a wire stretched from one end to the other. A current from eight or ten Grove cells, interrupted by a tuning fork which vibrates 128 times per second, is sent through the wire. At a distance about a fifth of its length from the end of the wire a large electro-magnet, with pointed poles, is placed so that the line joining the poles is at right angles to the wires. The poles are also put close to the wire, but leaving it freedom to vibrate. When a current from eight Grove cells is sent through the coils of the electro-magnet, the wire begins to sound, and by altering its tension the fundamental note of the wire comes out loud and clear. The wire is also seen to be vibrating as a whole; and the vibrations are also seen to be in the plane perpendicular to the line joining the poles. By shifting the electro-magnet a little, and regulating the tension of the wire, it is seen to divide into nodes and loops with one, with two, with three nodes in its length, thus giving the harmonics of the fundamental note. This effect is due to the interrupted current causing the wire to vibrate across the lines of force due to the electro-magnet; in fact, the magnet appears very much to perform the function of the bow when employed to agitate the wire in the ordinary way. I have tried different wires—iron, steel, and copper—all with the same result, which shows that the effect is not confined to wires formed of the magnetic metals alone. This experiment helps to explain the action of the wire telephone, and shows that it is due mainly, if not entirely, to the transverse and not to the longitudinal vibrations of the wire. By damping the wire at the requisite points along its length, the various notes of the scale can be distinctly reproduced. All the notes produced are distinctly clear and beautiful, and the effect of a slight alteration of tension in altering the tone is very marked. It is easy to see how an apparatus on this principle could be constructed by repeating Helmholtz's experiments on the vowel sounds.

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LAYING AND REPAIRING SUBMARINE TELEGRAPH CABLES.*

BY A. JAMIESON, C.E.

(CONTINUED FROM PAGE 310.)

But you would no doubt like to know how the position of the fault is arrived at, as this seems a mystery to all persons unacquainted with the laws of electricity.

I will try to make the matter plain to you by a few homely illustrations.

If you wanted to know the length of this lecture table, and were to call a carpenter or joiner to measure it for you, he would take out his rule, and having compared it with the table, he would inform you that it was so many feet and inches. You at once comprehend his answer, for the foot and inch are the units of measurement by which you and the carpenter and other intelligent people in this country are accustomed to compare and measure lengths.

Again, if you went to an ironmonger with this piece of lead, which is ten cubic inches, and asked him what weight it was, he would at once place it in one of the scales of his balance (see Fig. 1), insert known weights in the other scale (as I now do here), and tell you it was so many pounds and ounces (4lbs. or ·4lbs. per cubic inch). You at once understand him, for the pound and ounce are in this case your units of weight. Now, if you were to become the possessor of a piece of telegraph cable, say 100 miles in length (like this piece here), and were anxious to know its electrical resistance, you would call in an electrician, and say to him, "Tell me what number of units of resistance does this piece of cable offer to the passage of an electric current?" He would attach one end of the conductor to the cable to one side of his electric balance (see Fig. 2), put the other end of the cable to earth, adding known resistances to the other side of the balance, and tell you that the total resistance was 1,000 ohms, or 10 ohms per mile.

Fig. 1.

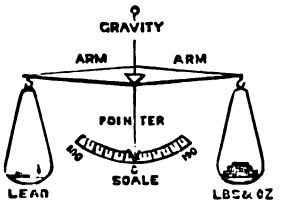


Fig. 2.

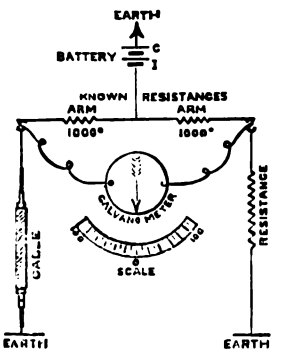
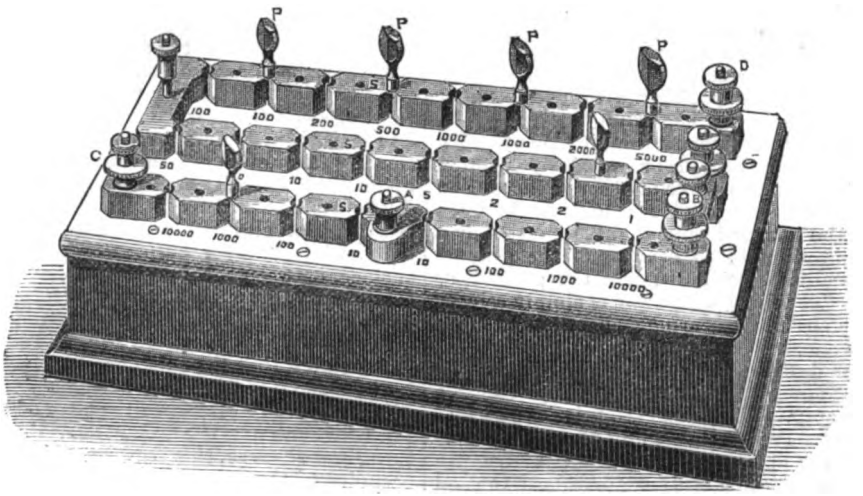


Fig. 3.



The ohm is, therefore, the "electrician's" unit of resistance, so called from the name of the person who first found out and demonstrated the laws relating to electric resistances. The method by which the "electrician" set about finding out this for you was similar in many respects to that by which the ironmonger found for you the weight of the lead, only a little more scientific, and perhaps at first difficult to understand; but by aid of this diagram and apparatus I have little doubt that you will see how the result is accomplished.

This pretty looking box here constitutes the "electrician's" balance, called generally "Wheatstone's bridge or balance" (after the name of the great electrician, Sir Charles Wheatstone). It also contains the counterpart to the ironmonger's weights (here pointing to box and part of diagram, Fig. 2, marked resistance coils 1,000 ω).

These resistance coils are made up of very fine and carefully adjusted platinum silver wires, well insulated by being covered with silk and wound upon bobbins, like ordinary thread pins. They are arranged from 1 ohm to 10,000 ohms, so that the electrician can measure the resistance of any conductor between these amounts with even or equal arms in his bridge. His detector here is Sir William Thomson's reflecting galvanometer, and occupies the place of this pointer in the ironmonger's balance, for, like the ironmonger, when he sees this pointer steadily pointing to the middle or zero of the scale, without inclining to one side or the other, he is quite satisfied that the weights he has put into the one scale are equal to the lump of lead you give him to weigh.

The constant force of gravity assists the ironmonger in ascertaining the weight of the piece of lead in the same way that a constant electric force from a good battery helps the electrician to ascertain the resistance of the cable.

You see the two balances as I have drawn them upon the board. The direction of the arrows indicates the direction of gravity and of the electric current in either case.

When the electrician observes no current flowing through his galvanometer, that is to say, when he sees the spot of light perfectly steady at zero, like the ironmonger his pointer, he knows he has got a balance, and he has then only to count up, or read off the resistance in circuit from this box, and that will be the resistance of the piece of cable, provided, of course, that the arms of his balance are equal.

Now, you will say what has this to do with finding the position of a fault in a cable. This I will very soon show you.

Suppose your cable breaks, and you cannot send any more messages, you again call for the electrician, for you are in a worse dilemma than before. He again brings forth his inevitable balance, works in exactly the same way, but finds, say, that he only gets 300 units or ohms of resistance, and that he observes the current to flow freely to earth without fluctuation; that is, that the fault or break is well exposed. He at once says to himself, when the cable was good and 100 miles long, I got 1,000 ω, or 10 ω per mile, and I also know it to be of uniform resistance throughout. I have only, therefore, to divide my 300 by ten, and I get thirty miles as the distance from this end. In order to make sure, however, I will take the first steamer, or the telegraph ship if possible, and go over to the other end with my never-failing balance under my arm. You say, by all means, as quickly as possible. I am in a great hurry to know where the break is. I am losing pounds upon pounds daily, and my opponent is getting all the traffic. Over goes the electrician, attaches his balance to the other end, and reports that he gets 700 ohms or units, and dividing the 700 by 10, says it is 70 miles from that end.

I have shown you the simplest possible case that could happen. It is not always so easy, yet that is the basis or principle upon which he acts. But as different as are the extremely fine calculations and weighings of the analytical chemist to those of an ordinary grocer, so are those of the submarine electrician to those of the man who runs up an ordinary wire along the streets for working a telephone.

Having found the electric resistance to the fault from shore in ohms, and converted it into nautical miles, he has then to plot off the distance on the chart, allowing carefully for any slack that may have been paid out, for although the length of the cable may be 100 miles, as in the case assumed, the straight distance across may be only 80 miles, or 20 per cent. slack, and thus it is possible to make a much greater error in plotting off the distance on the chart than the limit of nicety to which the electric tests directed you. However, by carefully

* A Lecture delivered at the Naval and Marine Engineering Exhibition, Glasgow, January 28, 1881.

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considering the data, and with some practice, the thing is generally arrived at pretty well.

During the operation of sounding, it is well to ascertain at the same time if any currents or tides exist, and the allowances to be made for these and winds during the future operation of grappling and lifting.

Soundings having been obtained, the next thing to do (if no good landmarks are available for taking accurate bearings) is to place a "mark buoy."

Mark buoys should be large, ride well, and with an easily distinguishable beacon fixed to the top of as tall a pole as the buoy will conveniently carry. "Bird cage" beacons are, as a rule, preferable to flags, from the frequent occurrence of the latter becoming entangled and wound round the staff, or not standing out well when the wind is light. Spherical silvered globes have been prepared, and no doubt would be easily distinguishable at great distances when the sun was bright, owing to the reflected rays, but they have not been practically adopted. At night, flags, beacons, or globes are of no avail, and we still lack a good plan of distinguishing mark buoys from sunset to sunrise. Lamps are used, but they necessitate the lowering and sending away of a boat's crew to fix them, which under the circumstances of heavy weather is impossible, and is always shunned if it can be avoided; besides, they are liable to become broken, upset, or extinguished. Buoys filled with gas upon Pintsch's plan, seen at the Gas Exhibition the other day, are perfectly satisfactory, and should be fitted to every telegraph steamer.

A good electric light, such as that now used in the navy and elsewhere, would assist in discovering a buoy at night; but I doubt whether it would be sufficiently handy to enable the ship to be kept up to within sight of a mark buoy on a rough, windy night. It has proved very serviceable in landing shore ends and lighting up paying-out gear, &c.

Now, having ascertained the depth of water, nature of the bottom (if possible) and currents, winds, &c., and fixed the position of our mark buoy by careful observations, we are ready to commence grappling. But before describing the operation, it may be as well to give a general idea of the grapnel system, as at present used, with the appliances for working the same. We have:—(1) Tank or platform for holding or supporting the grapnel rope, (2) Picking up gear, (3) Dynamometer, (4) Fair lead pulley, (5) Bow baulks and sheaves, (6) Grapnel rope, (7) Grappling chain, and (8) Grapnel. The grapnel (proper) is attached to about 15 fathoms of $\frac{3}{4}$ or $\frac{7}{8}$ grapnel chain. The chain in turn is shackled to the grapnel rope, which passes over the bow and fair lead pulleys, underneath the dynamometer pulley, and with three or, if necessary, four turns round the picking-up drum, ending in a coil, placed in a suitably arranged tank or platform behind the picking-up gear. The drum is revolved by a steam engine and gearing, either directly or indirectly attached to its framing. It can also be stopped or eased by friction brakes, suitably fixed to the pulleys on one or other of the motion shafts. The dynamometer is generally placed midway between the picking-up drum and the fair lead pulley, and indicates by a pointer and scale the strain brought to bear upon the grapnel rope, *e. g.*, when the grapnel is being drawn over the ground, or when elevating the cable. The fair lead pulley is simply a loose pulley, free to run upon a shaft and bearings, as well as to move longitudinally along the same, and consequently guide the grapnel rope from the bow to the dynamometer pulley, or *vice versâ*. The bow sheave is the last guide which the grapnel rope receives on passing from or to the ship. The grapnel rope is composed of steel wires, each wire being served with hemp, varying in size and strength according to the nature of the ground and depth of water. The grappling chain, which is attached between the end of the grappling rope and the grapnel shank, is generally 15 to 20 fathoms long, and composed of ordinary $\frac{3}{4}$ inch or $\frac{7}{8}$ inch chain, and serves to protect the grapnel rope from becoming worn on the ground, as well as to keep the grapnel more or less well-buried, and up to its work when in action. The grapnel itself is of various forms and sizes, according to the nature of the ground to be worked upon. For instance, there are long toed, short toed, self-relieving toed, centipede chain, and other grapnels; but for the present let us select the common centipede grapnel, with a trail chain behind to act as a damper or preventive against jumping, and commerce lowering it to the bottom of the sea preparatory to the grappling. The grapnel rope is lowered by the picking-up gear, and as a rotometer or length measurer is always attached, you can easily ascertain when the grapnel should be nearing the bottom. The ship should, therefore, be moved easy ahead, in order to prevent the chain and grapnel becoming jumbled in a heap, and care should be taken not to pay out rope in excess of the depth. When the grapnel and chain have reached the bottom, and a sufficient quantity of rope has been paid out to insure easy working without trailing the rope on the ground, the grapnel rope should be carefully parcelled or served with matting where it is likely to become chafed on the bow sheave, or fore-foot and side of the ship—a circumstance which is very likely to occur if there is any swell or up and down motion of the ship.

The operation of grappling is now fairly commenced, having taken precautions that all necessary stoppers and appliances are at hand, in the case of hooking cable, or the grapnel rope taking a run, under a sudden strain due to catching rocks. The ship should as far as possible be brought head to wind and tide, that is, working against any local forces, so that she may be the more easily checked in her forward movement should anything occur to require this being done; or she may be allowed to drift stern first, only moving the engines when it is required to keep her up to the course.

The responsible telegraph engineer or officer in charge now sits or stands upon the grapnel rope, watching the strains by dynamometer, but mainly trusting to the indications felt by the nerves of his hands, feet, or posterior. He can easily distinguish in shallow waters between the gradually (I might say, softly) increasing strain, denoting "cable hooked," and the sudden, sharp, wicked strain, intimating "rocks engaged." But in deep water, or when working on stiff clay bottom, it requires great experience and judgment to tell correctly whether the cable has been hooked or the grapnel is simply labouring through heavy ground. This difficulty is, of course, increased with the depth, as the vibrations and strains imparted to the rope are lessened and the indications consequently deadened.

Rocks are a great source of trouble, and have caused no end of breakages to grapnels, ropes, &c., besides great waste of time. It is no uncommon occurrence for a repairing ship to have three or four grapnels rendered useless in a morning's work.

In the meantime, let us suppose that we have been lucky in hooking the cable, and that we have commenced picking up. This is an operation which requires considerable experience, as the ship has to be carefully and expertly handled, so as not to bring any undue strain on the cable, as well as always to keep the grapnel rope vertical, or as nearly so as possible, in order to prevent the grapnel skidding or sliding along the cable. The speed of picking up should be so regulated that surging and jerking may be avoided. Many a cable has been broken during picking up by an over anxiety to bring it smartly to the surface and not giving time for the ship to come to, or easing out rope when she fell off. Of course the ease with which a cable may be picked up greatly depends upon the amount of *slack* originally laid. For cables laid in waters up to 1,000fms., it is most decidedly advisable to so arrange the slack according to the depth, that the cable may be picked up on the bight when the time comes for it to be repaired, and a safe rule would be to lay cables with 1 per cent. of slack for every 100fms. of *depth*. When a cable has to be repaired in waters over 1,000fms., it is only under exceptionally favourable circumstances that we can expect to bring it up on the bight without breaking.

The cable has firstly to be hooked, lifted a certain height and buoyed, then elevated or eased by a ship some 3½ miles from the buoy, while another ship catches and brings the cable to the surface, between the buoy and ship. To obviate all this trouble or difficulty, grapnels have been devised for cutting one side and bringing up the other, which we shall more particularly refer to later on.

Assuming that the cable has been successfully elevated to the bows, it should be securely stoppered on each side of the grapnel nip to lengths of strong coil or grapnel rope, the one leading over the starboard and the other over the port-bow sheave. With three bow sheaves this can easily be done, the central one being occupied by the grapnel rope, and those on either side for heaving in or slacking off one or other of the ends of cable.

There are two plans at present in use for stoppering a cable at the bows, both of which necessitate the lowering of a man over the side. The one is that of simply nipping the cable on the bight of a chain and link, and the other, certainly the more secure, although it may take longer time, is that of taking a rolling hitch and half-hitch with spun yarn seizings before and behind as well as through the last link of the chain stopper.

I think it might be quite possible to devise some means of clamp arrangement, whereby the loss of time and danger arising from stoppering the cable at the bows might be avoided, as well as a plan of severing the cable when stoppered, without having to let a man over the side in a boatswain's chair to effect the same with file and saw.

The cable having been securely stoppered on each side of the grapnel nip it should be cut, and heaving in commenced by picking up drum on the one side while slacking out on the other.

This plan is preferable to that of buoying one end, as it permits of having both sides tested and a knowledge of the electrical condition of the cable being ascertained before picking up

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towards the fault. It enables this to be done without materially altering the ship's position.

If the good side be first brought on board it can, of course, be sealed, let go, and buoyed before testing the other, unless (as is sometimes advantageous) shore should be informed how much may be expected to pick up, &c.

Suppose that the good side has been buoyed, that is, its end securely fastened to a length of chain with mushroom anchor, and sufficient buoy rope, with riding and bridle chains, &c., between the same and the buoy, it is always best to let the cable down to the bottom when buoying an end (not so in the case of a bight), and to, therefore, depend entirely upon the mushroom, buoy rope, and chain for holding the buoy from drifting, insuring at the same time that the cable, when once down, bears no part of the strain.

Everything clear, it is now time to pick up towards the fault. This is done by steaming the ship gently forward over the line of cable, elevating and taking it in at the lowest possible strain by the picking up gear, and coiling the same in one or other of the cable tanks. Sometimes the cable as it leaves the ground gets jammed in a rock, and great care has to be taken in extricating it without overstraining or breaking.

It is always a special point of interest to those engaged in repairing a cable, and more especially to the electrician, to see and examine the fault. Care should be taken when the fault or broken end comes on board to avoid jamming or altering its form or condition in any way before it has been thoroughly examined and tested, as every fault picked up has a history of its own, and tells a tale furnishing valuable experience.

All information regarding the fault should be collected, sifted, and arranged, in order to assist in dealing with and localising more correctly similar ones in future, and guarding against recurrence.

Of course, if a broken end comes on board, or the cable gets broken in picking up, the operation of grappling, hooking, and lifting the cable has to be repeated as just described, in order to secure the other end, and find that it tests all right.

Having secured it, and supposing that it tests all right, a joint and splice has to be made to the good cable on board which it is intended to lay in.

Jointing and splicing on board ship when out on a repair, have to be effected with the greatest possible expedition in order not to keep the ship hanging on to the cable longer than is absolutely necessary, and requires to be done by men specially trained for the purpose.

The process of jointing the conductor and (gutta percha) core of a cable at sea is a very interesting one, but, unfortunately, we have not time to consider it to-night. Preparatory to jointing, however, the sheathing and yarn servings have to be prepared and arranged according to the form of splice to be made. If the types of cable are of the same size and lay, a "factory splice" may be made, that is, the wires are inlaid; if of different types or lay, an "overlapping splice" will be best and quickest. In either case the iron wires on one side of where the joint is to be made have to be unstranded in *twos* and *threes* to a distance, say of seven or eight fathoms, bound there with spun yarn, and the core cut off within three or four feet of the fastening, while those on the other side are also firmly bound with spun yarn, but cut off square, leaving about two feet of core sticking out.

The yarn serving is neatly laid back and fixed to the iron sheathing on both sides, the two projecting ends of core being sufficient for the jointer to work upon without impeding him by the iron sheathing.

After the joint has been finished, cooled, and tested, the yarn servings are drawn forward and neatly bound over the joint to protect it from the sheathing.

The iron wires which were unstranded and laid back, are now brought forward, and either alternately inserted in the place of those on the other side, being cut off at distances of 5 to 6 feet apart, making (what we have just mentioned) a "factory splice," or drawn over and laid round the sheathing on the opposite side. The sheathing is seasoned here and there with small soft iron wire, and the splice, whichever way it may have been done, is tightly served with spun yarn, and is just as strong as any other part of the cable of the same type when well done.

Paying out the new cable is now commenced, and continued until the buoy attached to the other end is reached, when the buoy with its moorings, &c., and the cable attached is lifted and brought on board. Both sides are now carefully tested, and if all right, a joint and splice are made between the two ends, and the bight carefully let go over the ship's side, tightening it as far as required before slipping.

There are almost as many precautions and observances to be attended to in paying out a few miles as a few hundred. But in paying out a short length (anything up to 10 miles) it is best to pay it over the bows, as it saves the necessity for passing the cable from stem to stern, or *vice versâ*, when the first end buoyed has been reached. In fact, I am of opinion that it would be well if all repairing ships were fitted with break power on the same shaft as the picking up drum, suitably arranged for paying out, in which case there would be no necessity whatever for paying out machinery aft, resulting in a saving of first cost and room, besides dispensing with a lot of top weight, and confining cable work to the forward part of the ship.

(TO BE CONCLUDED.)

FAURE'S SECONDARY BATTERY.

The importance of secondary batteries as a means of storing electricity is beginning to be recognised by practical electricians, and M. Emile Reynier, the inventor of a successful electric lamp, is at present engaged in studying the subject.

The beautiful researches of M. Gaston Planté on the polarisation of voltameters have led that skilful electrician to the invention of very powerful lead plate secondary batteries, which can be used for storing the electric current. He has succeeded in giving them a great capacity by means of successive charges and discharges regularly produced, which develop on the surface of the lead a coating of oxide and reduced metal in a divided state, favourable to the production of the secondary current.

A Planté couple of half a square metre surface, properly made, can store a quantity of electro chemical energy capable of reddening during ten minutes a platinum wire of 1 millimetre diameter for 8 centimetres of its length.

M. Planté has chiefly applied these results to pure experiment. By the discharge *in tension* of a large number of secondary couples, originally charged *in quantity*, he has obtained very high electric tension.

The Planté battery has already taken an important place in laboratories; it is likely also to be useful in distributing the electric current, and, therefore, mechanical work, or, indeed, all forms of energy, light, heat and chemical action. But in order to attain this end it is necessary to give the apparatus a greater capacity, combined with a smaller bulk. These improvements appear to have been made by M. Camille Faure.

His secondary battery is derived from that of M. Planté. The electrodes are of lead, plunged in water, acidulated by sulphuric acid; but it can be more easily constructed. In Planté's battery the formation is limited by the thickness of the lead plates; but M. Faure gives to his couples an almost limitless power of accumulation by covering the electrodes with a layer of spongy lead, formed and retained in the following manner:—

The two lead plates of the couple are each covered with minium (red lead) or another insoluble oxide of lead, then enclosed in felt, kept in place by lead rivets. These two electrodes are then put side by side in a vessel of acidulated water. If they are very long they are rolled up like those of M. Planté. Thus constructed, the couple is formed by causing an electric current to traverse it, when the red lead is reduced to the state of peroxide on the positive electrode and lead upon the negative electrode. When the whole mass has been thus electrolised the couple is ready for charging.

On being discharged again, the reduced lead is oxidised, and the peroxide is reduced until the couple becomes inert. It is then ready for a new charge of electricity.

Practically one can store in this way a quantity of energy capable of performing a horse-power of external work during an hour in a Faure battery of 75 kilograms in weight.

The yield of the secondary battery of M. Faure can, under certain conditions, amount to 80 per cent. of the energy expended in charging it, a result which is in perfect accord with the theory.

TRAFFIC RECEIPTS FOR APRIL, 1881.

COMPANIES.	April, 1881.	April, 1880.	Increase.	Decrease
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company.....	—	—	—	—
Cuba Submarine Company.....	3,100 estd.	3,139	—	39
Direct Spanish Telegraph Company	1,337	1,453	—	116
Direct United States Telegraph Company ...	14,660*estd.	13,940†	720	—
Eastern Telegraph Company	45,289	44,748	541	—
Eastern Extension Telegraph Company	26,746	24,342	2,404	—
Great Northern Telegraph Company	17,720	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company..	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company.	—	—	—	—

* At 2s. per word. † At 3s. per word.

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THE ELECTRICIAN.

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ARC *VERSUS* INCANDESCENT LIGHTING.

The attention which has lately been bestowed upon the so-called incandescent system of electric lighting will probably result in its challenging the arc system, even on ground which seemed exclusively the property of the latter. We have no desire to predict what will be the result of this competition, and still less would we take sides, one way or the other, in any partisan spirit. But it seems to us that there are several important considerations in respect to incandescent lighting which have hitherto been overlooked, and which at this juncture it may be well to state with frankness as well as fairness.

The points we specially refer to might, one would have supposed, have been fully brought out in the discussion last week upon Mr. Lane Fox's paper at the Society of Telegraph Engineers. But nothing of the kind took place. It is true that one speaker remarked that arc lighting would always be the more general because of its superior economy, and another replied that, for his part, he thought incandescent lighting would become the more general. The value of these contradictory opinions would have been greater had they not come from persons who, on the one hand, knew little of any but the arc system, or who, on the other, owned a pecuniary interest in the incandescent system. Nobody else offered a remark on the subject, the debate being chiefly confined to the representatives of existing working concerns, interspersed with a few direct appeals from private individuals, and some half-hearted criticisms from engineering experts. The society, as a society, had no voice in the matter. Such discussions, except as advertisements, are utterly valueless. Nobody speaks his mind; and the one or two persons who are free to tell an unpalatable truth speak under a sense of doing an ungracious act. This was especially noticeable on the occasion to which we especially refer, when the character of all criticism was stamped beforehand by describing it as "antagonistic." We think this is greatly to be deprecated. There is no antagonism in an unworthy sense of the term discoverable anywhere, though there certainly is a natural amount of scepticism. Antagonism, however, may be expected if the advocates of this or that system attempt to force it upon the public, backed by calculations that may not be questioned, and contrivances that nobody shall examine. Making every allowance for enthusiasm on the part of inventors, and for generosity on the part of expert lookers on, we cannot but think that the policy of reticence is not a policy that will pay in the long run. When gentlemen of considerable means but little technical knowledge show their willingness to become converts if only they can get a plain answer to a very plain question, nothing but mistrust and suspicion are likely to come of evasions and vague generalities. These remarks apply to all discussions which, within our knowledge, have taken place of late; and of them we are inclined to say that a thorough-paced antagonist on the other side, saying all he could against electric lighting, and so provoking genuine debate upon points in dispute, would have rendered infinitely greater public service.

Were there such a discussion as we have just hinted at, probably some of the defects of the arc system would be brought into prominence bearing upon the particular subject of this article. That those defects have not been unduly pressed by the general public is proof that the general public is very indulgent, and is ready to extend its hospitality to any and every rival that promises to relieve it from the tyranny of gas. But, whenever this same public has had the opportunity of making the comparison, its verdict has uniformly been favourable to the incandescent lamp. Indeed, the praise bestowed upon it has been unqualified; neither in point of colour, of glare, of dazzle, or of excess, has any fault been found with it. This fact of itself goes a great way towards justifying Mr. Lane Fox's prediction. The question of economy is certainly a factor to be taken into account; but, at the present moment, when the economy of the arc itself over gas is by no means established, it is hardly consistent to argue for arc lighting on the sole ground of its economy over incandescent.

On this question of relative economy also we are still speculating with insufficient data. We have it on good authority that the confident calculations, based on theoretical considerations in relation to the subdivision—or, more correctly, multiplication—of arc lights, have not worked out so expensively in practice as was anticipated. The loss by multiplication is comparatively small. May we not look for a similar discovery in relation to incandescent lamps? But be this as it may, people who are willing to pay for what they like can be reckoned upon as customers for the costlier system. This we think is a conclusion fairly warranted by every exhibition we have witnessed during the past eighteen months.

But this is not all. It will be urged that the arc can hold

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its own by reason of its special fitness for outdoor illumination. Incandescent lamps by all means, it is said, for indoors, but the arc indisputably for open spaces. We repeat we have no interest or desire but to state the case clearly; but to be clear we must be candid, and it seems to us at least not proven that the arc possesses this alleged superiority. It is incomparable as a bright light, and it can be seen at a great distance; but the mistake about it is that its brightness is assumed to be a measure of its illuminating power. At all events, this is the mistake noticeable in all experiments hitherto. To put it briefly, there is a vast expenditure of brightness in its immediate vicinity, but a conspicuous lack of it a little way off. The remedy would be to place the lamps nearer together; but this would result only in making the extravagance of light, if not more objectionable, more wasteful and expensive. In short, there is quite enough light, but it wants distributing. On this account alone it may be confidently asserted that a scheme which lighted a street by means of a large number of small lamps would meet with a kinder reception than can be always predicted for one ambitiously planned to light it with only a few. To light a whole city with a huge electrical sun is a great scientific achievement; but it is not the sort of lighting that anybody wants, and if what is really needed can be had in another way, it is not to be supposed the public will patronise the more pretentious scheme out of compliment to science.

It seems, therefore, that in one important particular the small lamp, which is best represented by the incandescent or *quasi*-incandescent systems, has much in its favour; and when we add that ordinary human eyes can rest upon it without pain, and even with some relief, its competition with the arc is not so hopeless as some people imagine. It is pretty certain, for example, that the route from Charing-cross to the Houses of Parliament could be lighted as well, if not better, by incandescent lamps as by the improved burners which we owe to the affrighted zeal of an awakened gas company. But we are not so sure that the same could be said of any arc system. At all events, it has not been tried on the lines we have laid down as most likely to win the permanent good will of the public. On the whole, we are inclined to the opinion that the circumstances must be rare in which a multiplication of lights, rather than their concentration, would not be the most acceptable arrangement.

THE CONVERSION OF HEAT INTO WORK AND ELECTRICITY.*

BY M. MAURICE LEBLANC.

(CONTINUED FROM PAGE 296.)

Here is another example in which the phenomenon of dissociation is made use of. Copper salts give rise to numerous ammoniacal combinations. Take sulphate of copper as an instance. The first equivalent of ammonia which deposits itself on it cannot be removed, but this is not the case with the others. We can, therefore, imagine it to be sufficiently charged to enable a large quantity to be removed from it by making a vacuum above, at a low temperature, 0 for instance. I take a solution of this kind, and fill with it a receiver placed in a bath of water. This receiver communicates with a cylinder furnished with some means of distribution (Fig. 9). I introduce into the cylinder a mixture of the liquid and ammonia gas, and let it expand, first at a constant temperature, then adiabatically. Having done this, I have done a certain amount of work, and I ought to be able to make the mixed liquid and gas, which the cylinder contains, re-enter the first receiver.

The liquid and gas being separated according to their densities, can be removed separately by means of a pump into a flask. The liquid then re-enters the first receiver, in virtue of the *vis viva* produced in it by the pump.

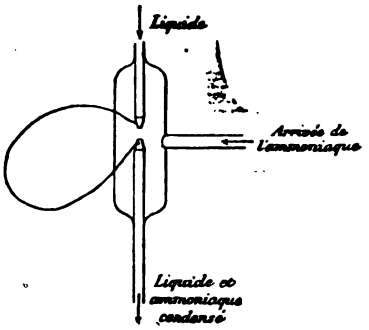

FIG. 9.

The two tubes of the flask are of copper, and are joined up in circuit. If this circuit be closed, the condensation of the gas which is given off between these two gives rise to an electric current. In fact, the first, *a*, comes in contact with a liquid less charged with ammonia than that which comes into contact with the second. Further, this cell is unpolarisable; copper alone is deposited by the first tube on the second. (I have further verified this phenomenon by experiment.) From this time the work done is necessarily positive. For, let *a b* and *b c* (Fig. 10)

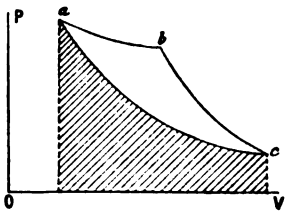

FIG. 10.

be the isothermic and adiabatic period of expansion in the cylinder. We may suppose that the pump gives to the liquid the exact force necessary to remove the gas, and to enable the whole of itself to reach a point of the isotherm *a*, *b*.

If we regard the line representing the changes in condition which the mixture in the flask undergoes, we shall see, as above, that this must of necessity be a line similar to *c a* situated below *c b*, without which we should arrive at perpetual motion. The shaded area *a c n m* represents the active force which the pump gives to the liquid.

We take as representing the heat obtained the line *a b*; we produce a quantity of work, represented by the area of the diagram *a b c*, and give off electricity along *c a*. Fig. 11 is a plan

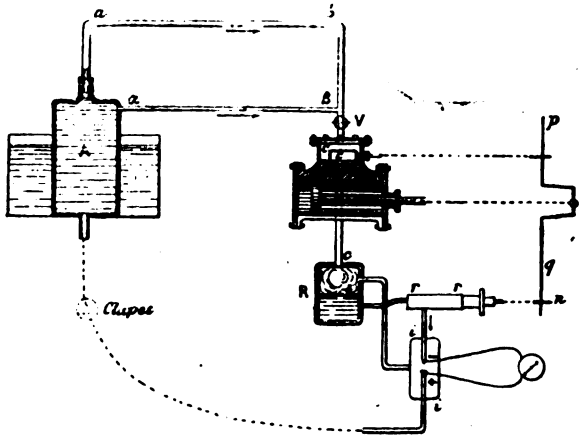

FIG. 11.

showing how this idea can be realised. We should have in this way a machine giving off electricity instead of heat in its condenser. There is, therefore, no need for cooling this.

Up to this point we have supposed a body will absorb heat or give off electricity according to a change in its condition determined by a variation of volume, or a lowering of the temperature at a constant volume. Now, I will show another method which allows the absorption of heat by means of internal reactions determined by Berthollet's law. Let us examine the battery shown in Fig. 12. A B is a jar divided into two compartments by a porous partition which does not quite reach the top of the jar. A and B are tin electrodes. In the compartment *b* is a solution

* Translated from *La Lumière Electrique*.

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of sulphate of zinc in an alkaline polysulphide. It is covered by a layer of sulphide of carbon. Above is a solution of sulphate

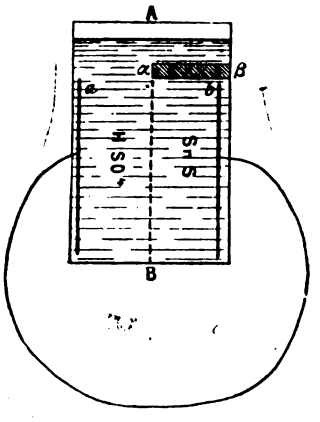

Fig. 12.

of zinc and sulphuric acid, which fills the compartment A. Under these conditions we have a first reaction

$$SnS + HSO^4 = SnSO^4 + HS,$$

of which the following is the action :—

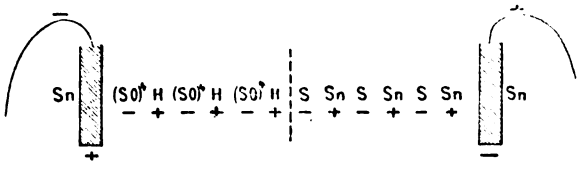

Fig. 13.

Sulphide of hydrogen is produced, which is disengaged, traverses the layer of sulphurous carbon, and reaches the upper solution, where it encounters the already formed sulphate. Then, according to Berthollet's laws, we have the inverse reaction

$$SnSO^4 + HS = SnS + HSO^4,$$

for sulphur is insoluble in acids. It is then precipitated, again traverses the sulphurous carbon, and is dissolved *de novo* in the alkaline polysulphide.

The object of having the sulphide of carbon is simply to permit of the sulphide and sulphate solutions being placed one above another without mixing. Thus we have a battery producing electricity continuously by expenditure of its internal heat. It would be necessary to change the position of electrodes from time to time on account of the transportation of metal which is constantly taking place from one to the other.

We have seen that certain salts when dissolved in water absorb heat. It is easy to convert this heat into electricity. Suppose we have two cells, A and B, of an ordinary battery, Fig. 14.

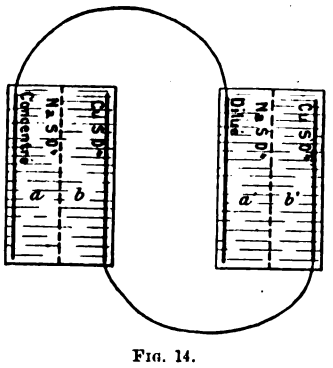

Fig. 14.

Place in *a* a receptacle containing an amalgam of sodium, and in *a'* a receptacle containing mercury. In *b* and *b'* place two sheets of copper in a solution of copper sulphate, which will serve as a depolarising body. In A put a highly concentrated solution of sodic sulphate. In *a'* put a highly dilute solution of the same chemical. Connect the two receptacles and the two coppers. There will be a current, the sodium of A will be attacked, and the sulphate of soda in B electrolysed, and the following reaction will take place in A :—

$$Na, Hg + CuSO^4 = Hg + Cu + NaSO^4,$$

whilst in B the inverse of this will take place.

But in A, $NaSO^4$ is formed within a saturated liquid, so that it will be deposited, whilst the $NaSO^4$ destroyed in B was in the first place very much diluted. We shall have, then, as the energy developed in the circuit, the energy absorbed in the form of heat by the sulphate of soda to pass from the state of highly concentrated salt, as in A, to the state of a highly dilute salt, as in B.

To keep this apparatus going for a length of time it would be sufficient :—

1. To place in B from time to time a part of the crystals precipitated in A.
2. To change from time to time the receptacles *a* and *a'*, as also the sheets *b* and *b'*.
3. To keep the two solutions of sulphate of copper always in an equal state of saturation by placing from time to time the crystals deposited in *b'*, in the solution *b*, which becomes weakened.

The cell B should be kept at a constant temperature.

Conclusion.

My work is far from complete, but I hope that, if I have made myself understood, I have shown a new method of conversion of heat.

This method of conversion is in strict accordance with Carnot's law, or with the principle enunciated by Clausius under the title of "D'Equivalence des Transformations," a principle of which Carnot's law is but one particular case, and which is exactly expressed by the condition

$$\int \frac{d\,Q}{T} \leqslant 0.$$

But it limits the generality of this more general law enunciated by Clausius :—"It is impossible to cause heat to pass from a cold body to a warm body without an expenditure of energy." In fact we have seen that it was possible to take heat from a source at a certain temperature, and to convert it entirely into electricity and work. From this it is clear that we are able after this to produce with it heat at as high a temperature as we please.

This phenomenon is only impossible when, in operating the transfer of heat, we make use simply of the property it possesses of leaving one body and passing into another, when they are in contact and are not at the same temperature. But it ceases to be so if, as we have done, we make use at the same time of the property possessed by electricity of transferring it from one point of a circuit where there is a certain difference of potential, to another point of the same circuit where there is a less great difference of potential ; or, what comes to the same thing nearly, if we utilise at the same time the property possessed by heat of passing naturally from one point to another, when the two points are united by the same circuit, and the electrical tension is not the same. (These differences of tension result from heterogeneous contacts, and not from a difference of temperatures.)

With regard to the practical side of the question, I proposed to make a thermic machine which should work without fall of temperature, and such, therefore, that its "boiler" could be lowered to 0 degrees. In this way we could directly convert the heat enclosed in bodies surrounding us, and, as an instance, utilise the heat developed in the freezing of water. We know that a litre at 0 degrees develops by its congelation 79 calories, which, when integrally converted, would give more than 30,000 kilogrammetres in the shape of work or electricity. A litre of water at 0 degrees, but liquid, which can always and everywhere be found, would furnish us with the same amount of work as this same litre of water falling from a height of more than 30,000 metres and moving a turbine.

I do not know whether it would be possible to construct on these principles (excepting the last two, which I do not think can be much utilised) a machine capable of moving itself ; but I believe I have shown the possibility of such a thing.

I believe we must look for a combination having a high tension of dissociation, even at a low temperature, and which, nevertheless, is produced with a great development of energy. These combinations, owing to their having a strong tendency to dissociation at ordinary temperatures, do not exist in nature, and I have no knowledge, up to the present time, of any researches in this direction. They would be of use for the construction of batteries of high E.M.F., which would only expend the heat absorbed from bodies at the surrounding temperature. There is no necessity for wishing to obtain work by direct conversion, dynamo-electric machines being, in a cynematic point of view, far more perfect than all the machines for realising a closed cycle.

In the meantime there is a more practical and easily attainable object, and one which, at the present day, has a certain importance. Granting that temperature may be raised, I have obtained very satisfactory results by dissociating sulphuric acid, according to M. Sainte-Claire-Deville's directions, and by recomposing it in a battery where the sulphurous acid dissolved in the water was the body attacked, and oxygen the depolarising body, as in Grenet's battery, or in Pulvermacher's. In this direction

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I made researches on an apparatus in which I burnt pyrites, where I obtained in electricity the heat given off by the reaction, $HSO^3 + O = HSO^4$, and finally, where I recomposed sulphuric acid. I will shortly give a description of this.

END OF PART I.

CORRESPONDENCE.

STRAY THOUGHTS ON THE HELMHOLTZ LECTURE.—II.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: For the fulsome and indiscriminate praise of Faraday I have no sympathy. English people are fond of worshipping at their own shrines; but how much more are they delighted when a distinguished foreigner comes to swell the chorus of praise. The voluminous researches of Faraday are, indeed, a big book, from which the most opposite texts may be culled. In respect of science, they depict a noble and successful career, though not without moral and intellectual slips, and on many points it would be pitiful indeed if we could not now see clearer and farther. We may cite two points in particular on which Faraday dwelt, one good as the other is probably bad. He was right in thinking that small quantities of electricity could not pass without electrolysis, but, both chemically and electrically, his best appliances were totally inadequate for the proof. How much has since been accomplished for these appliances, aided by mathematical research, is is most ably portrayed by Professor Helmholtz.

Faraday saw clearly in principle that the electric forces bound up in a grain of water might be equal to the most powerful and destructive flash of lighting. He also tried very hard to understand that condition of static polarity called the "electro-tonic," which exists in every magnet, or magnetic field, and also precedes every line of voltaic interchange.

We apply the potential of a Daniell cell across a vessel of acidulated water; the platinum poles are incompetent to produce *visible* electrolysis, but they have the power to set up the "electro-tonic" state through any length.

Let us try to imagine these poles, or the parts exposed, as almost infinitely small, not weighing more than 97 as compared with 8 of oxygen and 1 of hydrogen; we then have a condenser of the smallest capacity, with positive H at one pole and negative O at the other, and a corresponding linear constraint of positive and negative atoms between.

This condition of things may be spoken of as "electro-tonic," as a "condenser" (which is simply an arrangement for the manifestation of static positive and negative forces); or as polar lines of force, such as subsist between the poles of a magnet, and throughout its substance.

Augment the platinum surface, and these lines of force are proportionately augmented; so much so that Helmholtz has proved their existence with a potential of 1-1000th of a Daniell cell, and maintains that with larger surfaces the inverse reaction may be exhibited, so that the feebler tensions may be visibly demonstrated with the larger quantity; that is, with the augmented number of lines of polarity, in their reactive return to ordinary equilibrio.

The eminent Professor does not refer to this electro-tonic state as communicable *to any length*; but he wisely insists that these opposite ions cannot appear at the ends without corresponding motions throughout the whole length. And we might here well refer, not as a matter of feasable speculation, but of *actual fact*, to the possibility of telegraphing to America, or, indeed, to any length, as through an absolutely closed and perfectly insulated channel. We do not mean insulated in the ordinary sense or laterally, but perfectly insulated at each end. We only require terminal "condensers" with instruments sufficiently sensitive to appreciate the to and fro, or positive and negative condition of this polar or "electro-tonic" state.

As to the small quantities now appreciable, the Professor is able to observe the polarisation produced during some seconds of an infinitesmal current, that would require 100 years to decompose a milligramme of water (fifteen-thousandths of a grain).

As to the operative forces impressed on the atoms by which we are surrounded, and in thorough confirmation of Faraday's conception, the Professor states that the electricity separated from fifteen-thousandths of a grain of water, and communicated to two balls more than 1,000 yards apart (3,270ft.?), would produce an attraction between them equal to the weight of 55,000lb. Therefore, a grain of water would in this way represent a force of more than 1,600 tons.

This is the electrical side or aspect of the same facts, so well described by Tyndall, in regard to the enormous forces by which the chemical atoms fall together in chemical combustion.

As to the bad or questionable point, Faraday conceived of a distinction between water and other bodies which conducted electrolytically, and metals which conducted without electrolysis. This idea has been very largely speculated upon, and is probably entertained by the eminent Professor. It has always appeared to me unreasonable and unfair to view the electric circuit otherwise than as consisting of two equal halves, internal and external, fluid and metal. While Faraday was living Grove contended that chemical action mostly consisted of small and confused circuits of double decomposition, and that voltaism consisted of a similar series of double decompositions diverted into a linear circuit; and that the heat in one case, and the current in the other, were different manifestations of the same resultant of chemical forces. It is a convenient and empirical circumstance that the metal half may be indefinitely extended in wire connections or otherwise, due to the fact that copper conducts with enormous facility as compared with water or other electrolytes.

A little consideration will show that the same mechanism of conduction subsists in both cases alike, and that one is in every way the inverse compliment of the other.

Helmholtz is doing valiant work for the recognition of this principle in breaking down the distinction between insulators and conductors. It is with a master hand that he shows all alike are subject to the initial electro-tonic state; in other words, that they all similarly transmit a static chemical or polar affection of the atoms, where glass and gutta percha are no exceptions to the general rule.

Passing from this initial state to that of current or actual transfer or intercharge of atoms, the two halves are identically similar in every respect. The spiral inductive or magnetic effects are not only similar in principle, but they are quantitatively identical on either section, quite irrespective of size or situation. It is true we may insert wire lengths on the metal side, without any apparent electrolysis at the junctions; but, excepting the matter of conductivity, there is not one tittle of difference between these and similar insertions in the liquid half, where spiral insertions have been foolishly contrived to prove what was previously matter of certain knowledge.

In a lucid summary of researches on "Equipotential lines, &c." Mr. Gordon concludes thus—

"It is interesting to know that the conduction of a current in an electrolyte resembles that of a current in a metallic conductor as far as the lines of flow are concerned."

As to the unfairness of attributing all the end or polar functions to one half of the conditions, such would not be thought of for a moment in any case of chemical decomposition. If we look to the active or zinc end of the circuit, what have we?

The liquid half gives up its — ion (oxygen or chlorine) precisely as the metal half gives up its + ion (zinc or magnesium). One is the equal and antithetic compliment of the other.

As well might we say that the zinc lays hold of oxygen, and, therefore, the metal half is electrolytic, while the fluid is only a conductor without electrolysis, as to say the converse, which is so blindly taught in the schools.

I purposely omit any minute analysis of the other end or pole (with, however, a certain presumption of perfect analogy), because I cannot proceed without a minimum of hypothesis, to wit, that metals are binary compounds of M + E, where E is the material substance so predominant in electrical effects.

More tenuous than hydrogen, it yet remains to be identified and added to the list of ponderables; but as there is no E in the liquid half, it is almost a certainty that linear chemical arrangements will soon be contrived, where all the ordinary manifestations of electricity and magnetism will be evidenced without it.

I have tried in many ways to regard this E as some form of force, but never with any approach to reason or success.

Beyond circulating among friends during the last twenty years, a matured study of its history, function, and connections (a paper rejected by the Telegraph Society), I have hesitated to publish, from a deep dislike to hypothesis. It, however, now becomes a necessity that the subject should be fairly ventilated, and grand work is being done to prepare the way.

The electrolytic picture of Grotthus is now painted with more vivid colours by Helmholtz, but the truth and simplicity are marred by two hypothetic elements which are perfectly unnecessary. Of the ions referred to we know somewhat considerably, and especially of their enormous power in combustion.

Their static inductive effects upon other atoms is only a natural corollary; and from these initial, or end to end effects, the transition is easy to their spiral or transverse inductions in phenomena so well known to electricians.

In the double stream which follows static polarity, the ions cannot go through each other, and there is only one conceivable way

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in which they can travel, and that way would give them a mean transverse position all round, just such as corresponds with their inductive or magnetic effects.—Yours, &c.,

SAML. E. PHILLIPS.

16, Greenwood-terrace, St. John's, Hackney.

"A GLANCE INTO THE FUTURE."

TO THE EDITOR OF THE ELECTRICIAN.

SIR: It is rather hard upon the prophetic suggestion put forward in a letter bearing the above title in your issue of 9th April that nobody of eminence has condescended to notice it. Perhaps, however, your correspondent may take comfort in observing that people of eminence are all nowadays busily concocting theories and predictions on their own account. Every schoolboy knows that one cow's tail, if it is long enough, will reach to the moon; but the application of the cow's-tail method of exposition to the predictions of science is just now the surest way to solid fame at the hands of full-grown men. It may be, therefore, that envy at his forestalling them in a most original—perhaps *the* most original—suggestion will account for the unmannerly reticence of scientists. If I were a man of eminence I should be bound to say that I had tried Mr. Salomon's scheme for transmitting individuals by electricity several years ago, and had devised many improvements upon it—in fact, some final experiments and additional capital only were needed to make the thing a practical success. But not being eminent, I can afford to be good natured; and I should like to offer your correspondent a few helpful suggestions. Substantially the proposal is to obtain a "human solution," or an "elementary molecule," of a man in London, so as to build him up by electro deposit at New York. My first suggestion is that Mr. Edison be consulted; for, if he has not patented the process already, he is sure to lend a willing hand to a modest venture of this kind. As to the human solution, your correspondent speaks of a man being dissolved by electric means in London. On this point Messrs. Siemens might be consulted with advantage, for I believe they have succeeded in dissolving one or two good men in this way very satisfactorily. But, failing them, any popular novelist will dissolve a woman to tears in less than one volume; and, at a pinch, perhaps the solution thus obtained might suffice for a rough experiment. The elementary molecule of a man is not so easily obtainable; the nearest approach to it we know of is a journeyman tailor; and although one-ninth of a human being is largely in excess of a human molecule, it is a good stride in the right direction, and a tailor's tailor would presumably bring us still nearer. On a general view of the case I think our main difficulty will be, not in getting people willing to submit to the final operation—there are plenty of old boys walking Pall Mall and the Strand, who would be only too eager to be "built up"—but in obtaining the necessary consent to the pulling down. With the help of school boards, popular science, and technical colleges, however, we may confidently hope that the rising generation will joyfully run any sort of risk in the interests of progress and true enlightenment.—Yours, &c.,

May 4th, 1881. B. A. M. BOOZLE.

TRANSPARENT ELECTROMETER SCALE.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In your paper of the 30th ultimo I observed a letter by Mr. Wm. O. Smith, regarding priority to the transparent galvanometer scale shown by Mr. F. Jacob, at the Helmholtz *soirée*.

The following facts may be interesting to you and your readers. In September, 1873, while I was in charge of Sir William Thomson and Professor Fleming Jenkins' staff inspecting the manufacture of cable being made at Messrs. Siemens Brothers, Charlton, for the Platino Brazileira Telegraph Company, South America, Mr. Robert H. Harrison, from Ware, one of the gentlemen assisting me at the time, complained of loosing readings on the electrometer scale from his head getting between the mirror and the "spot," and he asked me to make a transparent one. I at once saw the advantages that would accrue, especially as we were testing two cables at one and the same time by Professor Jenkins' electrometer method, and the readings required to be taken very accurately and quickly, as the potential of the core coils or cable in the tank fell, and consequently the spot travelled along the scale. Mr. Harrison and I set to work, and constructed a transparent scale, which for cheapness and handiness will no doubt recommend itself to your readers. We took one of Mr. White's (of Glasgow) one-half metre scales which are divided into 1,000 equal parts, and carefully traced on strong stout tracing paper a facsimile of this scale which we had before been using in the ordinary way. We set it up on a stand by itself, and arranged it so that a clear circular spot of 1¼ inches diameter of light fell upon it from the mirror, with a fine vertical wire or hair division or mark in its centre. As the "spot" travelled along the scale it lit up the figures and divisions on the same, and we read off *from behind* the number opposite the hair mark.

Mr. Jacob was second electrician on Siemens' staff at the Charlton works at the time we used this scale. This original idea is earlier than the one accredited to the "American gentleman," and as far as I know it was the first time a transparent scale was constructed and practically used in a testing room.—Yours, &c., ANDREW JAMIESON, Principal.

College of Science and Arts, 38, Bath-street, Glasgow, May 4, 1881.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I knew perfectly well I had only to publish an improvement in any instrument to find that it had been done years before; but it is quite evident to me that it has *not* been done in the way I have done it, or it certainly would be in use now.

The fact that Mr. W. O. Smith states (of the requirement of a more darkened room) is completely at variance with what I stated in *Nature*; and his powers of observation must be small, or he would have noticed that a brilliant electric light was burning only a few feet off the scale, as exhibited at the Helmholtz *soirée*.

The only requisite is that there should not be a strong light *behind* the scale; and as testing instruments are generally placed on tables round the wall of the testing rooms, and not in front of the windows, there is no disadvantage in this way.

I believe what has been done before is to have a transparent scale *in toto*, which of course renders it hard to read off the divisions; whereas my divisions are on an opaque ground, and the hair line alone on the semi-transparent glass screen.—Yours, &c., F. JACOB.

Charlton, May 2, 1881.

DESTRUCTION BY LIGHTNING.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The accident which occurred on the 26th ult. at the Board School in Orange-street, Southwark, is another proof to me how little care is taken even by such institutions (otherwise so well managed) as the London School Board to protect life and property against the destructive influences of the fiery flashes from the clouds. It is more than a century since Benjamin Franklin showed us the simple method of protection against lightning, and it may seem almost incredible that hundreds of buildings are still annually destroyed and hundreds of lives lost by these discharges of electricity. I have just received an official letter from the Minister of Commerce of Italy, informing me that during the sixteen years from 1864 to 1879, no less than 1,906 lives were lost in that country through fatal accidents from lightning. I beg to append a list of these casualties as I received them from Rome. Can meteorological influences be traced to the astounding preponderance of accidents in certain years such as 1868 and 1873?—Yours, &c., RICHARD ANDERSON.

Rose Cottage, New Malden, Surrey, May 2.

DEATHS CAUSED BY LIGHTNING IN ITALY IN THE YEARS 1864-1879.

YEAR.	DEATHS PER YEAR.	MALES.	FEMALES.
1864	91	72	19
1865	76	54	22
1866	54	43	11
1867	98	62	36
1868	237	186	51
1869	109	79	30
1870	110	75	35
1871	99	76	23
1872	134	101	33
1873	184	136	48
1874	167	128	39
1875	137	96	41
1876	147	114	33
1877	92	66	26
1878	100	82	18
1879	71	52	19
Total	1,906	1,422	484

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THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

At the meeting of this Society, held on Thursday, 28th April, Mr. LATIMER CLARK, Vice-President, in the chair, the adjourned discussion was resumed upon Mr. George Lane Fox Pitt's paper relating to the application of electricity to the purposes of lighting and heating.

Mr. SHOOLBRED, being asked to offer some remarks, said that he was not so well acquainted with the subject of incandescent lighting as with the arc systems; but that he thought the paper was a valuable contribution to the efforts now being made with a view to solve the difficulties of electric lighting on a large scale in the future. Mr. Lane Fox Pitt's method of distribution seemed to be a very suggestive and, under certain conditions, a practical one. He had not touched at all, however, upon arc lighting, which, by reason of its economy, would naturally take a prominent place if electricity were applied to lighting generally. Mr. Shoolbred also mentioned that much more information was needed, especially with regard to the capabilities of conducting cables for long distances.

Captain SALE took exception to the comparisons upon which the calculations had been based as regards the cost of coal, pointing out the actual cost of coal was only half its equivalent of gas; and in other details he thought that the data were speculative and misleading.

Mr. ALEXANDER SIEMENS disagreed generally with the theoretical portion of the paper, and he thought some of the purely scientific speculations might have been rendered in a more practical form. For example, as to the storing of electricity, to all intents and purposes this might be expressed in the phrase, "bank up the engine fires." This was done in the case of the British Museum, where on foggy days the engines were so kept that in ten minutes steam could be got up. With reference to some of Mr. Shoolbred's questions, he (Mr. Siemens) contended that there was even now not the least difficulty in providing every shop in the city of London with electric lights if only the orders for them were forthcoming. Engine room would have to be found greater than the space at present available, but in other respects all that was needed was customers. Earth could be used, and was used, instead of a return wire, if due care be taken to make it good; and the machines themselves could be joined in multiple arc or series, and were capable of being made to suit any purposes whatever, small lights or large lights, many or few.

Mr. DONOVAN repeated the question which had been asked at the previous meeting,—In what respects did Mr. Fox Pitt's lamp differ from Mr. Edison's and Mr. Swan's?

Mr. C. F. VARLEY offered some observations upon the technical portion of the paper, demurring to the term elastic being applied to electricity, and describing Faraday's experiment in proof that it is incompressible. He, Mr. Varley, could not entirely accept Clerk Maxwell's definition of electricity, or that other view of it held by the opposite school. He rather took an intermediate stand, inclining to the safer statement that it was a *vehicle* of force.

Mr. CROMPTON supplemented his remarks at the previous discussion by stating that, as the light of the future would never do to depend upon the safety of a single working engine, it would always be necessary to work with numerous small ones. That being the case, and the smaller engines consuming most coal, he feared that the paper had considerably underestimated the true expenditure on this item. In practice, 2¼lb. per hour per h.-p. was as low as they could safely count upon.

After some brief remarks from Professor PERRY, who criticised the table of calculations exhibited before the meeting; and from Mr. J. A. Betts, who recommended the adoption of a simpler nomenclature for the several modes of joining circuits—direct, divided, parallel, being terms more intelligible than those now commonly introduced,

Mr. ST. GEORGE LANE FOX PITT replied categorically to the remarks of his various critics. He could not help thinking that the discussion had exemplified what he had stated in his opening address, namely, that there was some antagonism to be overcome in the promoting of electric lighting. Mr. Shoolbred, however, had done him justice in rightly understanding the paper to have been mainly suggestive and prophetic of what we may reasonably expect from the electric light of the future. He could not agree that the arc light would still continue in general use, for he was distinctly of opinion that the incandescent systems would supersede the other entirely. As to the question of the respective claims of Mr. Edison and himself, he had the highest opinion of that eminent American inventor, and would be the last man to depreciate his ingenuity. Nobody could claim exclusive rights in incandescent lighting; but, as a matter of fact, his own patents dated prior to Mr. Edison's earliest, and, therefore, he (the speaker) had some right to be heard on this matter. He agreed that a simpler nomenclature would be an improvement, and pointed out that even "incandescent," as descriptive of the distinction between his class of lamp and the arc class, was erroneous, "bridge" lighting, he thought, being a more accurate term. In conclusion, he believed he had shown that there were great possibilities in store for electric lighting, and even for electric heating; that the best arrangements for steam power were capable of an economy not inferior to the low figures employed in his calculations; and that there was no reason to suppose that a carbon filament absolutely indestructible would not soon be discovered.

The usual votes of thanks concluded the proceedings.

ON A SIMPLE FORM OF SELENIUM CELL, AND EXPERIMENTS THEREWITH.*

BY PROF. JAMES BLYTH.

The cell is constructed as follows:—

Take a brass crop-comb of the kind usually worn by little girls. Cut off from it two equal parts, each about 4 inches long. From each part cut out each alternate tooth, and bend round each part in the form of a cylinder, soldering the ends together with hard solder. Take a glass tube about 4 inches long, and having a diameter equal to the diameter of the cylinder. Place the brass cylinders upon the glass tube, with the teeth facing each other, and adjust them so that each tooth left takes the place of one which has been cut out, taking care that the teeth do not touch each other nor the solid parts of the cylinder.

Now heat the cylinder in a Bunsen flame to a temperature sufficient to melt selenium—about 220° C—and rub a stick of selenium over the spaces between the teeth, so that each space gets filled with selenium, which will now be in an amorphous condition. To anneal it, place the whole in an air-bath at a temperature of about 150° C for an hour or so, when the selenium will assume a metallic and crystalline appearance. Allow it to cool gradually, and then solder on two copper wires to the solid part of each brass cylinder to serve as electrodes. The cell is now ready for use.

In order to show the action of light on the cell I placed it over a glass tube containing a singing flame, and connected it in circuit with a battery of six Grove's cells and an ordinary telephone, or still better a Gower-Bell telephone. The note produced by the singing flame was faintly but distinctly heard in the telephone placed in a distant room. It will be readily seen that in this experiment we take advantage both of the heat and light effect upon the selenium, and that the action is increased by the close proximity of the cell to the flame.

If the india rubber tube carrying the gas to the singing flame be rapidly pinched and let free the increase and decrease of the flame is instantly indicated by the telephone, and if the pinches are made rhythmically a corresponding rhythm is heard in the telephone.

The above experiment can also be very well performed by attaching the singing flame jet by an india rubber tube to one of Koenig's manometric capsules screwed on to an organ pipe. The note of the pipe is then heard in the receiving telephone.

Having obtained a cell which was sensitive to a singing flame, it was an easy step to try if it would be equally sensitive to the variations of the flame of a Koenig's capsule produced by singing and speaking. To test this I placed the cylindrical cell over the flame, so that the flame was in the axis of the cylinder and exactly opposite the selenium. When the cell was now joined up in circuit with fifteen Grove's cells and a telephone, not only singing but speaking was distinctly reproduced in the telephone.

This experiment is very remarkable, as it shows that the resistance of the selenium must vary with very great rapidity, otherwise it could not transmit articulation.

Flat cells of the comb form are very easily constructed by simply screwing the combs upon a flat piece of wood, taking care that the teeth do not touch each other. The whole is then heated up to the melting point of selenium, which is then rubbed carefully between the teeth. The annealing is a matter of great importance. It can be done very well in an air-bath, whose temperature can be regulated by a thermometer. During the time the cell should be joined up in circuit with a Wheatstone's bridge, and its resistance carefully tested all through the annealing process. It will be found that the resistance of the cell gradually diminishes with a rise of temperature, and finally attains a minimum, after which it begins to rise again. At that particular point further heating should be avoided, and the cell allowed to cool slowly. During the cooling the resistance rises, and does not appear to reach its final value till the cell has been some time in use.

* Proceedings of Royal Society of Edinburgh.

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It is obvious that what is wanted to make a selenium cell as sensitive as possible is to have a long thin layer of it between two parallel conductors forming the electrodes, and so to arrange it that as great a length of that layer as possible can be brought at once under the influence of the source of light. These conditions are well fulfilled in what may be called the *radial* cell, which consists of a series of brass sectors with very acute angles fixed upon the end of a wooden cylinder, and having narrow radial slits between them. This form is easily made by first fixing a disc of brass about 3 inches in diameter upon the wood, and then cutting it right through by a saw along a series of diameters equally inclined to each other. The odd number sectors are connected by one wire which forms the one electrode, and the even numbers by another wire which serves for the other electrode.

My first supply of selenium running down, I ordered a second, and proceeded to make another cell exactly in the same way as I had made the previous one. This cell, however, when finished, presented some very troublesome and perplexing peculiarities, inasmuch as its resistance during annealing fell very low—to something like 120 ohms, and yet it was almost entirely insensitive to the action of light. This effect is, without doubt, due to some impurity in the selenium, which I hope to detect by a chemical analysis which is being made for me.

The failure to get good selenium led me think if anything else would serve as a substitute, and the first thing I determined to try was amorphous phosphorus. I took a radial cell and packed the slits full of the phosphorus, and then proceeded to test its resistance in the ordinary way, but was surprised to find that I could not get a balance. This led me to see that the cell itself was acting as a battery, and on trying it directly through the galvanometer the needle was deflected off the scale. I also observed that the current varied with pressure on the phosphorus, and this suggested to me that it might be made to serve the double purpose of battery and loose contact in the ordinary form of microphone transmitter. For this purpose I made a special transmitter, which consists of a shallow wooden box having a disc of brass in its bottom to which one electrode is attached. Above this is placed a thin layer of the red phosphorus, and the whole enclosed by very flexible brass plate, bound down round the edges, and having the other electrode attached to it. A mouthpiece is arranged so as to direct the voice against the centre of the thin brass plate. When this transmitter is joined up in circuit with a telephone, singing and articulation are distinctly reproduced. When a battery is included the sounds come out of the telephone with singular clearness and loudness, and there is also a very remarkable want of any rattling, such as is usual with an ordinary microphone. I have also found that the cell, which is really a form of loose contact, can act as a receiver as well as a transmitter; but my experiments on it in this capacity are as yet incomplete.

SUBMARINE CABLES TRUST.

The tenth ordinary annual meeting of the certificate holders in this trust was held on Tuesday, Mr. J. PENDER, M.P., in the chair.

The SECRETARY (Mr. Lewis Wells) read the notice convening the meeting, and the report of the trustees was taken as read.

The CHAIRMAN said the report and accounts contained a very full statement of the position of the undertaking, but before asking them to adopt the report he would make a few remarks. They commenced the year with a substantial balance, namely, £2,539, which was further increased by the sum of £1,696, the dividend on the Eastern shares. This properly belonged to the revenue of the previous year. Aided by these amounts the trustees had a sum of £25,913 at their disposal. The expenses were exceptionally heavy in consequence of law proceedings, which put them temporarily under the direction of the Court of Chancery. These expenses amounted to £1,647, instead of the usual £1,300 or £1,400, leaving a balance of £24,264. Of this sum £20,442 was absorbed in paying coupons, £3,046 was carried to the redemption fund for the purchase of certificates, and the balance, £777, was carried forward. It would be in the recollection of the certificate holders that last year the Atlantic companies were in keen competition, carrying telegrams for a long time at unremunerative rates. The dividend in the Anglo-American dropped, and the return was reduced to 3¼ per cent. That ceased on the 1st October, since which time the Anglo-American had been earning a fair dividend. He was, however, sorry to say that a further competition was projected, which, if not avoided, might for a time affect their revenue. They were, however, able to pay the coupons during a former period of competition, and the trustees hoped to be able to do the same again under similar circumstances, more especially as they hoped to get a little more return from their investment in the Eastern companies. Under the trust deed the trustees had power to sell any of their securities at 30 per cent. above the cost price. Coupled with that condition was the proviso that the proceeds should be invested in the purchase of certificates. There was a very limited market in the certificates, the price was either very high or they were almost unsaleable—unsaleable simply because they were not very much dealt in on the Stock Exchange, excepting by investors, and not in any way by speculators; but, seeing their way to obtain a good number of certificates at a moderate price, the trustees disposed of 300 Eastern Extension shares at a profit of 40 per cent., and purchased certificates at an average price of 105¼. The trustees did not deem it advisable to extend the operation, and the result showed that they acted wisely, inasmuch as the Eastern Extension shares had risen on an improved dividend, and the price of the certificates had fallen to a little over par. Fifty-seven certificates were bought during the year, leaving the number outstanding 3,397. It was stated in the report that one of their auditors, Mr. Newmarch, had been too ill to audit the accounts. He had been far too unwell to be spoken to on matters of business, but was now in a fair way of recovery. The accounts had been audited, as usual, by Mr. Griffiths, and the meeting would have to elect auditors for the current year—a matter which rested, of course, with the certificate holders, but the trustees would recommend, so far as the board was concerned, that Mr. Newmarch should be re-appointed. They thought it would be rather discourteous to him, during his illness, to pass him over: therefore they thought it would be wise and proper on the part of the shareholders to elect him. In conclusion, the chairman moved "That the report and accounts now presented to the certificate holders be received and adopted."

The Marquis of TWEEDDALE seconded the motion.

Mr. MARTIN asked whether the trustees could inform them what amount of competition was likely to come from America? It was rumoured that Jay Gould was going to lay a cable, and some one else.

The CHAIRMAN replied that Mr. Jay Gould had said, when interviewed, that he meant New York to be the centre of telegraphy. Mr. Gould was a very powerful man, and a man of enormous wealth; but he had taken in hand a rather difficult game, and he (the chairman) supposed there were two parties could play at the same game. If competition should arise, the board would regret it, but they would be prepared to meet Mr. Gould on his own ground.

Mr. MARTIN: Is that the only competition threatened? We hear of another cable.

The CHAIRMAN: The more the merrier. I should have less fear of half-a-dozen competitors than of one. One is possible; but not half-a-dozen. But we do not know of any other; we hear of all sorts of rumours. There is one thing that must strike shareholders who are watching these affairs—all the submarine cables of the Atlantic are at 50 per cent. discount; therefore it is scarcely to be conceived that men who go into these companies for the purpose of benefiting shareholders will do so with their eyes open and pay 20s. to-day for what twelve months hence will be worth 10s. Still, it was done the other day with the French Company. We told the promoters within a year their shares would be at 50 per cent. discount, and they are, and I have no hesitation in saying that if Mr. Gould goes into this competition the capital of the Western Union which he has taken hold of—80,000,000 dollars—within a year of this time will not be worth 50,000,000 dollars, for this simple reason:—If any new company comes up, 10,000,000 dollars would do all the work that is required; therefore, the prospect of a fight with Mr. Gould with such an enormously inflated and watered capital is a very heavy burden for him to carry. If competition springs up there, Mr. Gould's 80,000,000 dollars will probably be worth 30,000,000 or 40,000,000.

Mr. STRINGER asked for an explanation with regard to the value of the certificates, which could be only sold at about par, while. if reckoned by the price of the securities held by the trust, the quotations should be 116 or 117.

The CHAIRMAN replied that there was but very little dealing, and no speculation in the certificates. People who purchased them did so as an investment. The depressed price was, no doubt, a good deal owing to the rumours about fresh Atlantic cables, it being thought that, if there were to be competition, the certificates might go down, and therefore their certificates were neglected.

Mr. STRINGER: But 16 or 17 per cent. difference is very considerable.

The CHAIRMAN: If you go into market just now to buy the certificates, there is just as much difficulty to buy them as to sell them, there is no dealing in them.

The motion was then put and carried unanimously.

Mr. G. Griffiths and Mr. Newmarsh, the retiring auditors, were re-elected.

A vote of thanks having been passed to the chairman and directors.

The CHAIRMAN returned thanks on behalf of himself and colleagues, remarking that if even Atlantic competition should arise, he was in hopes that the prices of other telegraphs would go in a different direction, and that with the growth of telegraphy they would be participators in the general advantage.

The proceedings then terminated.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices May 4.		Business Done Week Ending May 4. Highest.		Lowest.	
Anglo-American	56,	¼	58¼		56	
Do. Preferred	86,	¼	88¼		86	
Do. Deferred	28¼,	9¼	30¼		28¼	
Brazil Submarine	10¼,	¼	10¼		10¼	
Cuba	9,	¼	9¼		9¼	
Do. Preference	16½,	17	16½		16½	
Direct Spanish	3¾,	4¼	—		—	
Do. Preference	13,	14	—		—	
Direct United States Cable	11,	¼	11¼		11¼	
Eastern Telegraph	9 7-16,	10	10		9 13-16	
Do. 6 per Cent. Preference	12¾,	13	13		12¾	
Do. 5 per Cent. Debentures, 1899	103,	105	—		—	
Eastern Extension	11,	¼	11¼		11	
German Union	—,	—	11¼		11¼	
Globe Telegraph and Trust Company.	6¾,	¼	6¾		6 7-16	
Do. Preference	12¼,	¼	12¼		12¼	
Great Northern	12¼,	¼	12¼		12¼	
Indo-European	29,	30	29¼		29¼	
Mediterranean Extension	2¼,	¼	2¼		2¼	
Do. Preference	9¼,	10¼	10¼		9¼	
Reuter's	11,	12	11¼		11¼	
Submarine	270,	290	283		283	
West India and Panama	2¼,	¼	2¼		2¼	
Do. 1st Preference	¼,	¼	7¼		7	
Western Brazilian	8¼,	¼	9		8¼	
West. Union 7 per Cent. 1st Mortgage	120,	125	—		—	
Do. 6 per Cent. Sterling Bonds	104,	108	—		—	

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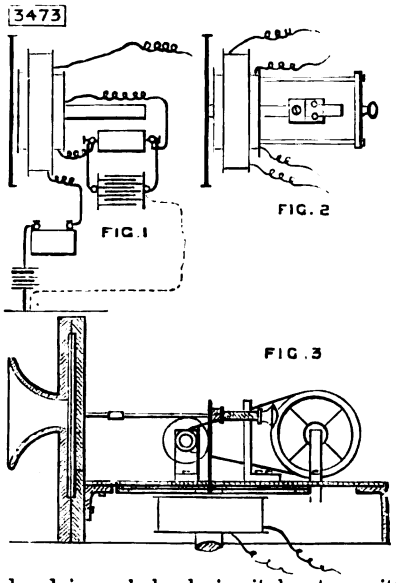
ABSTRACTS OF SPECIFICATIONS.

3438. SECURING TELEGRAPH WIRES TO THEIR INSULATORS, *A. E. Gilbert.* — *Dated 25th August*, 1880.—(*Void.*) 2*d.*

This consists in the construction and use of a bow-shapened fastener, clamp or clip, made preferably of malleable iron or malleable cast iron, having its free ends hooked or turned round so as to embrace or grip the line wire some inches in advance of and beyond the insulator, and pull it firmly into the groove on one side by the insertion of the strong hollow central breast or bow part of the clamp or clip into the groove of the insulator on the other side, the curve of the bow clamp or clip being such as to pull and slightly bend the telegragh wire on each side of the insulator towards or in a line through its centre, so that the tightness or strain of the tightening up of the wire thus effectually and automatically secures the wire and its clamp on or within the groove on each opposite side of the insulator.

3473. IMPROVEMENTS IN APPARATUS FOR TRANSMITTING AND RECEIVING SIGNALS BY MEANS OF ELECTRICITY, *A. F. St. George.—Dated 27th August*, 1880. 10*d.*

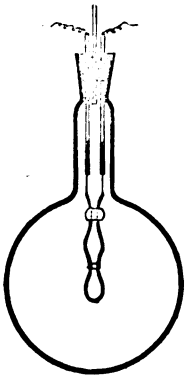
Fig. 1 shows the arrangement of the apparatus for transmitting signals. A metallic bar is surrounded with an internal coil and an external coil of insulated wire with a vibrating diaphragm. The main line wire through which the current is transmitted round the external coil by transmitting apparatus is shown. The current then passing to earth by another wire or through a return wire. An adjustable resistance apparatus is placed in the circuit, or the transmitter may be placed in an independent or local circuit which influences the main line circuit by induction, so that signals



produced in such local circuit by transmitter induce like signals in circuit which are transmitted to receiving instrument, or, as shown in figure, the condenser may be so arranged that the current through the inner coil may be made to pass as desired to it, or through the adjustable resistance apparatus. The disturbing currents induced in the main line, and which it is desired to suppress, pass through the outer coil of receiving telephone, and induce corresponding currents in the inner coil. These induced currents in the inner coil pass in an opposite direction and are opposed to the currents passing through the outer coil. Another arrangement is to make the inner coil movable and separate from the outer one, so that it can be made to move lengthways along the metal bar or core within it, so that the inner coil may be withdrawn more or less from the inside of the outer one. This is shown in Fig. 2. Another part of the invention is an apparatus by means of which sonorous vibrations of the air produced by any sound are made to impinge upon the elements of a thermo-electric generator, so as to cause variations in the current, which are transmitted along the line by a transmitter. One kind of transmitter is a bar of carbon, one end of which is carried by a metal support of German silver or other suitable material, which forms one of the thermo-electric elements, to which is connected the circuit wire. The other end of the carbon bar rests in a cavity of a carbon block, capable of being heated by a lamp. Another part of the invention consists of an apparatus for producing vibrations in a diaphragm by currents.. Opposite to one of the poles of a magnetic bar the inventor fixes a metallic diaphgragm, which is thus drawn towards the pole; these are so adjusted that between them can be arranged a wire or coil bent spirally, or backwards and forwards in a plane parallel to the diaphragm, the ends of the wire being connected with the circuit. When variations are produced by the transmission of signals in the electricity traversing the wire, they produce corresponding variations in the magnetism operating between the diaphragm and the pole, the field of which they traverse and affect, and corresponding vibrations are produced in the diaphragm. Another method of producing signals by vibration of a diaphragm is shown in Fig. 3.

3494. IMPROVEMENTS IN ELECTRIC LAMPS, &c., *St. G. Lane Fox.—Dated 28th August*, 1880. 6*d.*

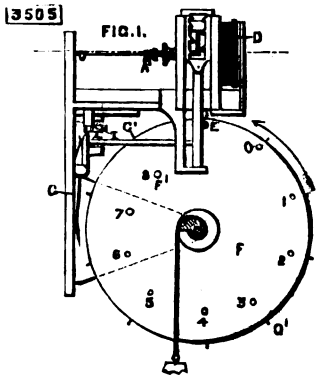
The Fig. shows the inventor's lamp on the incandescent principle; with lamp globe, luminous bridge or burner, made of vulcanised fibre which has been baked and then carbonised by heating to a white heat in benzole vapour; small block of porcelain between the ends of the bridge to keep them apart; pair of metallic clips through which the current passes, and which press against the outer surface of the ends of the bridge, and so form the electrical contact; these may be made of steel wire passed through and cemented to a



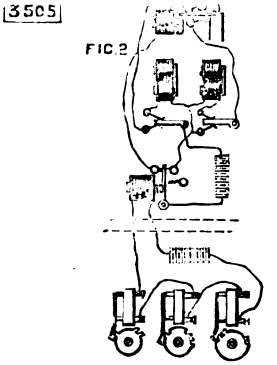
block of porcelain (borax fused by a blow pipe is a good cement for this purpose). The upper ends of the carbon have soldered to them short pieces of platinum wire, which enter the lower ends of and are fused into glass tubes, which latter are filled with mercury, so as to prevent leakage into the lamp; the mercury also forms the electrical communication between the luminous bridge and the outside of the globe. These glass tubes, and another tube which connects the globe with the apparatus by which the lamp is exhausted, pass through and fit tightly in holes in an india rubber stopper which closes the neck of the globe; this latter is slightly tapered to prevent the stopper being forced in by the pressure of the atmosphere. The upper surface of the stopper is covered by a layer of mercury to make the joint airtight. To prevent the mercury being spilt, some marine glue is placed above it. The inventor describes at length the mode of preparing his luminous bridge or burner, and the method of exhausting the lamp with his special apparatus, which is also described. The lamp having been thoroughly exhausted, a current is passed through it so as to render the burner incandescent, the pumping action (of the exhauster) being continued as rapidly as possible. The incandescence and pumping must be continued until nothing more comes off, or for about two or three days, when the tube leading to the exhaust pump is melted near the top of the lamp, and the latter thereby sealed from the atmosphere.

3505. ELECTRIC SIGNALLING TELEGAPHS, &c., *G. W. Clark. Dated 28th August*, 1880.—(*A communication*). 10*d.*

The object of this invention is partly to transmit signals and partly to actuate indicators. Each station has mechanism for rapidly opening or closing the circuit, which act operates on the receiving instrument at another point. The indicator has the usual visual movable letters or figures. Fig. 1 shows a side elevation of the in-



dicator. D is an electro-magnet with armature on lever A, which lever vibrates to or from the magnet. At the end of A is a pallet for engagement with escapement teeth C C on rack. The rack is mounted on vertical guides. The teeth are so proportioned to the pallet that on the release of a tooth on one side a tooth on the opposite side is engaged, and so the fall is through



a distance equal to that between two teeth. Thus the action of an armature of electro-magnet provides means to obtain a step to step motion and to obtain the movement necessary to indicate the different letters or figures. Fig. 2 shows the circuit connections for form of apparatus preferred.

VULCANISED FIBRE (Patented).

THE NEW SUBSTITUTE FOR

Metals, Hard Wood, Ivory, Vulcanite, Ebony, &c.,

And is extensively used by ELECTRICIANS as an INSULATOR.

Sold in Sheets 3ft. 6in by 5ft. 6in., from one-fiftieth to an inch in thickness, at 2s. 3d. per lb.

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Manufacturers of Iron and Steel Ropes for Colliery and Railway purposes. Rigging Ropes, Guide Ropes, &c.

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ELECTRIC LIGHTING.

THE

ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION

(LIMITED).

Capital £800,000; First Issue £400,000.

VICTORIA WORKS, BELVEDERE ROAD, & VINE STREET, LAMBETH.

The Corporation is prepared to give estimates, and to book orders for the SUPPLY of MACHINERY and LAMPS, upon the Brush System, for lighting up Factories, Warehouses, Railway Stations, Docks, Streets, &c.

The Corporation is also prepared to receive applications for licences, or for concessions for defined districts, and to enter into negotiations with responsible parties for the sale of licences for the British Colonies. The superiority of the Brush system in economy and simplicity being thoroughly established, its rapid development is now assured.

By the Brush system any number of lights, from 1 to 40, each of 2,000 candle power, or any number from 1 to 12, each of 6,000 candle power, or a single light of 50,000 or more candle power, can be produced from one dynamo machine. The connecting wires may be extended over circuits of many miles, and it is claimed that economy, constancy, and simplicity are secured at a less cost than by any other system.

All inquiries to be addressed to the Secretary, at the temporary offices, 74, Hatton-garden, London, E.C.

NORTHERN FIRE and LIFE ASSURANCE COMPANY.

Established 1836.

Head offices—Aberdeen and London.

Subscribed Capital	£3,000,000
Of which paid up	300,000
Fire Reserve Funds	637,977
Life Funds, as per last account	£1,462,146

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Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

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Letters of Credit and Circular Notes issued.

A Pamphlet, with full particulars, on application.

31st March, 1880. FRANCIS RAVENSCROFT, Manager.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS

PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

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THE "JAMIN" PATENT ELECTRIC LIGHT,

COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.

Capital 8,000,000 francs.

Proprietors of the Gramme Patent Machine for alternate currents.

J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

NOTICE OF REMOVAL.

EDWARD PATERSON,

TELEGRAPH AND ELECTRICAL ENGINEER,

3, BEDFORD COURT, COVENT GARDEN, W.C.,

Will on and after the 1st May, 1880, REMOVE to

76, LITTLE BRITAIN, ALDERSGATE STREET, E.C

The Gower-Bell Loud Speaking Telephone.

TELEPHONE LINES ERECTED and MAINTAINED

EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.

Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

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LONDON WAREHOUSE: F. WINTER.

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EBONITE.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby

ADDRESSES.

TAYLOR and Co., Mica Merchants, 90, HATTON GARDEN, LONDON.

W. T. GLOVER and Co., Insulated Wire Manu-facturers, 25, BOOTH-STREET, MANCHESTER. Works: 4 and 5, BRIDGEWATER-STREET, BROUGHTON-ROAD, SALFORD.

Specialities—Specially covered Gutta Percha Wire for Leading-in, Tunnel, and Underground Work. Specially covered Iron Wire for Aerial Lines. Fancy covered Copper Wire (Paraffined) for Telephonic and Bell purposes. Cotton covered G.P. Wire for Bell Work. Special Makes of Electric Light Leads for the Brush, Gramme, &c., systems.

All classes of Covered Wire and Cables for Telegraphic, Telephonic, and Electrical Work, as supplied to the Post-office and the principal Railway and Telephone Companies.

RANSOMES, HEAD, & JEFFERIES, Orwell Works, IPSWICH. London Office: No. 9, GRACECHURCH-STREET, E.C.

Specialities—Portable, Vertical, and Stationary Engines, fitted with patent governors, as used in the electric lighting on the Thames Embankment, London, &c.

BRITISH ELECTRIC LIGHT COMPANY (Limited), HEDDON-STREET, REGENT-STREET, LONDON, W.

Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.

Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.

Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.

Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

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SLIP

CABLE INTERRUPTED.—The Amoy-Shanghai cable is broken.

ASIA.—The telegraph line is restored between Wladivostock and Blagowestchensk.

THE ELECTRIC LIGHT AT ROUBAIX.—This town has just made trial of the electric light.

RUSSIA.—Direct telegraphic communication has been established between St. Petersburg and Geok Tepé.

THE TELEPHONE AT ST. ETIENNE.—This town, the capital of the department of Loire, has become possessed of a telephone exchange.

THE LEGION OF HONOUR.—M. Gaston Planté, the well-known electrician, has just been created Chevalier of the Légion d'Honneur.

ELECTRIC LIGHT AT BOMBAY.—The electric light has been adopted lately at the Bombay Club, where four lamps are kept burning every evening.

ELECTRIC LIGHT AT ROME.—During holy week the Colosseum was lighted by the electric light. The effect is said to have been grand in the extreme, the details of this splendid ruin being well defined.

ELECTRIC LIGHT FOR THEATRES.—The Municipal Council of Vienna have adopted the suggestion of their engineer, Herr Franz Haberkorn, that the theatres of that city should be illuminated by means of the electric light.

PARIS TELEGRAPHS.—Since the reduction of the tariff to 50 centimes as the minimum cost of a message the telegraph service has been so inundated with work that frequent delays have arisen in spite of the efforts of the officials.

MAXIM V. EDISON.—The appeal taken by Mr. T. A. Edison in the interference case of "Maxim against Edison," has been decided against Edison's claim by the "Board of Examiners-in-Chief" of the United States Patent Office.

SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—At a meeting of this society on Thursday last, Mr. Preece read a paper on "Recent Researches in Radiophony," an account of which we hope to give in our next issue.

THE AUSTRIAN MARRIAGE FESTIVITIES.—The electric light played an important part in the festive illuminations on Monday last at Vienna, in honour of the marriage of the Crown Prince of Austria with Princess Stephanie of Belgium.

THE ELECTRIC LIGHT AT BRUSSELS.—Trials have been made with the Clerc lamps in this town. The galleries of Saint Hubert were lighted by four of these lamps, which are said to have replaced 150 gas burners. Mr. Clerc calls his lamps "suns."

STORNOWAY.—The delay in repairing the cable to Stornoway has been due to the difficulty of obtaining a suitable ship. Such a vessel, Mr. Fawcett stated in the House of Commons on Monday last, has now been obtained, and is about to proceed to the spot.

CITY GUILDS INSTITUTE.—On Tuesday last Prince Leopold laid the foundation stone of the new college for the advancement of technical education recently established by the City and Guilds Institute, in Cowper-street, E.C. The building is estimated to cost £25,000.

TELEGRAPH CLERKS' GRIEVANCES.—Mr. S. Macliver, M.P., has received a letter from the Postmaster-General on this subject, in which he says that it is still being carefully considered, and that he (the Postmaster-General) hopes before long to announce the decision which may be arrived at.

BRAZILIAN SUBMARINE COMPANY.—The next half-yearly general meeting of this Company will be held at the Cannon-street Hotel at 1:30 p.m. on Friday, the 20th of May, to receive the directors' report for the half year ended 31st December, 1880.

THE SWAN LIGHT AT THE ROYAL SOCIETY.—At the annual reception by the President and Council of the Royal Society, on Wednesday evening, the 7th May, the library was illuminated by the Swan electric light, which was worked from an Otto gas engine in the basement. The light was steady and clear.

THE TELEPHONE IN EGYPT.—A Central Telephonic Exchange has been established at Alexandria, in St. Mark's-buildings, near to the Bourse. The subscribers already number over two hundred. In Cairo, too, telephonic communication has been established between the houses of Messrs. Colvin and Baird.

THE TELEPHONE IN CHINA.—The Chinese are going to establish a complete telephone system throughout the country, commencing north of the Yang Tse Kiang. The work will be done under the supervision of Mr. J. A. Betts, under whose superintendence the telegraph line from Tientsin to Taku was built.

PRICES.—The prices as quoted are:—For gutta percha, per lb., genuine 4d. to 3s. 3d., reboiled 3d. to 1s. 3d.; india rubber, per lb., Para, fine, 3s. 6d., negrohead 2s. 5d., central American 1s. 11d. to 2s. 6d., Assam and Pegu 1s. 2d. to 1s. 11d., other East Indian 1s. 9d. to 2s. 2d., Madagascar and Mozambique 1s. 6d. to 2s. 4d.

LEGAL.—A Maclean's telegram from New York, dated 3rd of May, says that the Weston Electric Light Company has brought a suit against the Brush Electric Light Company for an infringement of their patent, and asks for an injunction to prevent the latter from making, using, or imitating the Weston Light, or using any of their improvements.

BRAZILIAN SUBMARINE COMPANIES.—The traffic receipts of the Brazilian Submarine Telegraph Company (Limited) for the week ended May 6 amounted to £3,782. Those of the Western and Brazilian Telegraph Company (Limited) amounted to £2,589, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

TELEGRAPH WIRE, POLES, &c., WANTED.—The Great Eastern Railway require tenders for supplying india rubber, telegraph wire, fir poles, galvanised iron, and materials, &c. Forms of tender on application at the Secretary's office, Liverpool-street Terminus, E.C. Patterns at the Stores, Stratford, where they may be seen between 10 a.m. and 4 p.m. Tenders to Mr. J. Hadfield, the Secretary, by 10 a.m. on the 28th instant.

COMPLAINT AGAINST THE ELECTRIC LIGHT.—The Campbeltown steamer "Kintyre" was proceeding up the Clyde early on Thursday morning, and after passing Greenock Steamboat Quay she ran aground at Garvel Point. She was got off when the tide rose, and proceeded to Glasgow. It is stated that the cause of her getting out of the regular channel was the glare of the electric light on the Steamboat Quay blinding those in charge.

ELECTRIC LIGHT FOR FRENCH LIGHTHOUSES.—The Lighthouse Commission has, says *La Lumière Electrique*, given its hearty assent to the plan of M. l'Inspecteur Général

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Allard for lighting the coasts of France. The idea is to establish along the maritime coasts a system of large electric lights, capable of producing the same results as are now produced by means of oil. The expense of this change is estimated at eight million francs.

Scientific Thieves.—Referring to our recent note under this head, in which we stated that the telegraph office at Mean Meer, India, had been broken open, but that the only thing stolen was some carbon paper, *L'Electricité* hopes that the thieves may turn up with their booty in Paris, and sell it to M. Cochery, the Minister of Posts and Telegraphs, carbon paper not yet being employed in the French offices, though it has been used in England for many years.

Electric Railway in Paris.—The Municipal Council have granted the request of Messrs. Siemens Brothers to lay down an electric railway. During the exhibition a terminus will be established near La Concorde, opposite the Passy 'bus office, and the line will run from there through the east gate to the interior of the exhibition. After the close of the exhibition it will be transferred to the Champs Elysées. We congratulate Messrs. Siemens on the result of their request.

West India and Panama Telegraph Company.—The report of this company for the half year ended December last states that the receipts amounted to £19,694. To this is added £5,842 brought from last half year's account, and £5,372, an amount set aside in previous periods in respect of depreciation of the ss. "Investigator," no longer required, making a total to the credit of revenue account of £30,908. The expenses have amounted to £28,952, leaving £1,956 to be carried forward to the credit of next half year's account.

India Rubber Goods Wanted.—The Wallasey Local Board require tenders for the supply for twelve months, from the 30th June next, of india rubber goods. Further particulars and forms of tender on application at the ferry manager's office, Egremont Ferry, and at the gas and water manager's offices, Great Float, near Birkenhead. Tenders to be addressed to the Chairman of the Ferry Committee, and left at the office of Mr. T. Somerville Jones, clerk to the Wallasey Local Board, Church-street, Egremont, Cheshire, by 5 p.m., on the 18th May.

Celestial Poetry.—On a fan presented by the Marquis Tsêng as a mark of his esteem to Mr. Fryer, of the Foreign Translation Department in the Imperial Publishing Office, the following verse, composed by the Marquis himself, was written in Chinese. The translation is freely given in *Nature* as:—

Nine years have elapsed since our last conversation;
But your translations have been forwarded to me from time to time.
May your fame surpass that of Verbiest and Schaal,
As an electric light exceeds the spark of the glowworm.

The Electric Light in Photography.—The application of the electric light to photography has been turned to advantage by Mr. J. E. Mayall, of 164, New Bond-street. The advantage to be gained is obvious, viz., that the electric light is always available, sunlight is not. Mr. Mayall works a light said to be of the enormous power of 12,000 candles, by means of a machine mounted on a deep bed of concrete, which ensures steadiness; the motor is a 10 h-p. gas engine. Mr. Mayall has succeeded so well in his studio in Bond-street that he has carried wires to two other studios in Grafton-street. The electric light is said to be far superior to sunlight in defining features and bringing out expression.

The Edison Company: Further Issue of Shares.—The Edison Electric Illuminating Company of New York has authorised 750,000 dols. of the stock to be offered for subscription at par to the stockholders of the Edison Electric Light Company in the proportion of two shares of the stock of the latter company for three shares of the stock of the illuminating company. No subscriptions can be received for fractional parts of a share. Payments will be required as follow: 5 dols. per share at the the time of subscription, 20 dols. on allotment, 25 dols. on June 1, 1881, and the remaining 50 dols. to be called in on ten days' notice, as required, not earlier than 25 dols. July 1, and 25 dols. August 1, 1881.

The Brush Light in New York.—The plan of the Brush Electric Illuminating Company for the lighting of Union and Madison-squares, New York City, is similar to that on which the city of Wabash, Ind., is lighted. A hollow iron pole 150 feet high will be erected at a central point in each square. On the top of the pole there will be a group of six lights, each of 6,000 candle-power, arranged on a triangular frame. Within the hollow standard will rise and fall a weight to balance the triangle so that it may be lowered easily for replenishing the carbons. The wires which supply the current will be led to the lamps from some tall neighbouring building, and will be invisible at night.—*Engineering News.*

Lightships and the Telegraph.—A petition is in course of signature with the object of connecting lightships and the shore by means of electric telegraph. It runs as follows:—"To the Honourable the Commons of Great Britain and Ireland in Parliament assembled—The humble petition of the undersigned inhabitants of the United Kingdom sheweth, 1. That your petitioners, after hearing of the awful wreck of the "Indian Chief," are convinced that telegraphic communication is required with the Goodwin Sands, Kentish Knock, Long Sand, and other light ships round the British shores. 2. Also we believe that an increased supply of steam tugs round the coast would be very useful in saving lives and property of great value.

More American Companies!—The Bankers' and Merchants' Telegraph Company has been organised and incorporated, with a capital of 1,000,000 dollars. The company is to build lines between Boston and Washington, by way of New York, Philadelphia, and Baltimore. The stock has all been taken by bankers, brokers, and merchants in New York, Boston, and Philadelphia. From Mexico we hear that a Mr. A. K. Owen, who represents some Massachusetts capitalists, proposes building a railway and telegraph line, 500 miles in length, from Eagle Pass on the Rio Grande to Topolovampo Bay on the Pacific Ocean, about one hundred and eighty miles above Mazatlan. Another company calling itself the Eastern Telegraph Company has also been organised at Augusta, Me., with a capital of 500,000 dollars.

Quick Work.—An American paper says:—The result of the City and Suburban race at Epsom was transmitted to the National Associated Press over the Direct Cable Company's wires, and was published in the *Graphic* (New York) ahead of all other papers in the United States, or Europe. The report was filed in London at nine minutes and a half past eleven o'clock, New York time, and was received at the cable office in that city at fourteen minutes past eleven. Six minutes later the report was in the hands of compositors in the *Graphic* office, and within seventeen minutes' actual time from the filing of the report in London the edition of the *Graphic* containing it was for sale on the streets of New York. It should be borne in mind that this report was transmitted by the Direct Cable Company at a time of day when the commercial business is the heaviest, and the prompt manner in

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which it was handled is illustrative of their resources in an emergency.

SCIENCE AND CULTURE.—*Apropos* of our leading article a fortnight ago, Mr. Russell Lowell, acting as chairman at the anniversary dinner of the Royal Literary Fund, on 4th May, spoke as follows:—"A few days ago a very eminent literary man remarked at a dinner that the study of literature had now become optional, while the study of science had become obligatory. He could not help thinking that that gentleman took too despairing a view of the situation; and certainly no English writer better represented pure literature than the man who made that remark. It seemed to him (the chairman) that literature and science so overlapped each other that no straight line of distinction could be drawn between them, and nothing was more remarkable in men of the highest imagination than the ease with which they had moved from one side to the other. In Goethe, for example, they found that union of the understanding and the imagination. Science could never extinguish imagination. Human nature wanted something more juicy than mere facts, and so long as the human race lasted, wonder and delight in imaginary things would spring up with childhood. Wonder was the raw material of imagination, and helped to mitigate the hardships of practical everyday life."

THE ELECTRIC LIGHT AT THE POST OFFICE.—The electric light has for the past few nights been tried in that portion of the Post Office devoted to the sorting out of newspapers and circulars preparatory to transmission to their various destinations. The room used for this purpose is extremely large, from 400 to 450 persons being daily at work in it. The light used is the Brush. A visit was made to the Post Office on Tuesday evening by a number of gentlemen interested in the question, under the direction of Mr. John Scudamore Sellon, vice-chairman of the company, and Mr. Pamphilon of the Post Office, for the purpose of witnessing the effect produced. This seemed to be all that could be desired, the room to all intents and purposes being as bright as day. The new system of lights has done away with the 400 gas jets with which the room was previously lighted, 16 of the Brush lamps, each equal to 2,000 candles, being substituted. By this means the temperature has been reduced by nearly ten degrees, and the reading of addresses by the *employés* much facilitated. Indeed, the whole feeling of the latter in regard to the matter is greatly in favour of the new lighting apparatus. The electric machine is driven by a Brotherhood engine of 14 horse-power, supplied with steam from one of the great boilers.

A GOOD LEAD!—"The spectacle of a gas company undertaking to light by electricity the principal thoroughfares in their district would be decidedly novel, and might be considered as a visible advance towards the period when the lion and the lamb are to lie down together in mutual confidence." Such are the words of the *Gas Journal*, in a note on the offer of the Alliance and Dublin Consumers' Gas Company to light Sackville-street and College-green of that city, at their own expense, with electric lamps of the most approved type, the entire control of the arrangements being left with the corporation, who are only asked to provide a site for the engine and generators, and to take the trouble of nominating the working staff. Now, why should this be novel? Why have not the gas companies profited by the advice we gave them some time ago — taken the bull by the horns, and shaken hands with their powerful competitor? Why should they not supply electricity as well as gas? The more they procrastinate the less likely are they to have an opportunity of supplying either gas or electricity; every day fresh companies are projected in order to bring forward some one or other of the various systems of electric lighting that have sprung into being so rapidly of late; each company that is created is a fresh obstacle in the way of the gas companies, yet they, like the deaf adder, refuse to hear. We heartily congratulate the Dublin Company on their spirit, and wish them every success in their enterprise. We do not doubt that the experiment will not be money thrown away, and that the company will have its pluck and energy rewarded at no distant period of time. We hope that this example may not be lost, and that having been shown the way, other companies may follow.

THE CITY OF LONDON IN ECLIPSE.—Our contemporary the *Gas Journal* was puzzled, but it is so no longer. We cannot omit to publish what it has to say:—"When the intention of the Commissioners of Sewers to introduce electric lighting in several miles of the city of London streets and bridges was first announced we were somewhat puzzled to find out the reason why such a heavy undertaking was to be entitled an 'experiment.' Now we know. On Monday night the Brush lamps, which have been so much admired since they were lit up on the last day of March, suffered an unexpected total eclipse of several hours' duration. On this occasion the line of thoroughfares lit by the Anglo-American Electric Light Company, extending from Blackfriars to the middle of Cheapside, was left in darkness on a rainy night until the gas could be lit up by a suddenly improvised gang of lamplighters. The electric light appeared again on the following evening, but on Thursday last and several subsequent nights the gas was permitted to resume its wonted duty, while some extensive alterations were being carried out by the electricians, with a view, it is understood, to prevent the possibility of another failure, which is said to have been caused by defective insulation of the buried line-wires. Being an 'experiment,' of course the electric light is not supplied under any penalty for interruptions or defects in the arrangements; but although we have no desire whatever to attach undue importance to the circumstances in question, the great fact still remains that the system of street lighting by electricity has again broken down. The heavy rain of Monday night is credited with having either induced or betrayed the faults in the cable from which the current escaped, with the result of extinguishing all the lamps on the circuit. This may be so, but the excuse is surely almost as bad as the accident itself. In any case, the event is clearly another illustration of the absolute necessity for perfection in a number of interdependent parts, by which alone dynamo-electric force can be generated, distributed, and used. We are continually being told by enthusiastic electricians, such as Mr. Lane Fox and others, that it is much easier to distribute and use electric currents than it is to do the same by gas. These gentlemen doubtless believe what they say; but we candidly own that we should more readily give credit to the tale if it were not repeated so frequently. Here, at least, we have a positive fact, in the late failure of the Brush system, that the distribution of electricity, to be used for street lighting, is as yet by no means free from difficulty. The present trouble will, of course, be soon got over, but perhaps not so quickly forgotten." We will only add one word. Our contemporary says, "The system of street lighting by electricity has broken down." We think not. One of the systems has temporarily done so, the others are going on their way placidly and satisfactorily. However, we do not want to spoil the ray of hope that has flashed upon our contemporary, so we will say no more.

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CORRESPONDENCE.

EARTHQUAKES AND ELECTRICITY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The recent fearful earthquake at Scio in the Turkish Archipelago, compared with the preceding shocks at Casamicciola in Ischia, and those of last autumn at Agram, show such a marked increase in strength, density, and continuity, and consequently in each case a greater sacrifice of life and property that nervous people living in countries subject to these awful visitations are naturally considering whether *their* turn is to come next, and whether they are to anticipate being bodily engulphed or swept away into the depths of the sea.

So very little is known as to the origin of these shocks, and so many are the theories, more or less erroneous, advanced thereon that one hesitates before propounding any new one, yet I think in this, the age of science and statistics, we ought to be in a position to form an opinion which, even if it be not the actual one, shall not practically break down, as all others have hitherto done. I am not acquainted with any existing work treating on the subject, but it is a known fact that some years ago an English lady, after having very exhaustively treated the matter in theory, came to Zante in order to confirm her ideas and opinions by actual experience of a shock. By a remarkable coincidence, whilst in the act of stepping from the boat ashore, the great earthquake, known as that of St. Luke's day, 1839, took place, and it evidently so upset her ladyship and her conclusions, that not only did she immediately leave the island, but her book, which was shortly to appear and revolutionise all existing theories, was nevermore heard of.

All the Ionian Islands, with the exception of Corfu, the Greek and Turkish Archipelagoes, Crete and Asia Minor, are particularly subject to earthquake shocks of a more or less severe character, but unless they are alarmingly strong the people generally take them as a matter of course, and when the rocking is over think no more about it.

There is certainly this advantage about earthquakes, viz., that the shocks are nearly as swift as thought itself, and hardly give one time to conjecture what is about to take place ere they cease or have crushed you to powder. But when such fearful upheavals take place as at Scio old alarms return, and until time has toned down the remembrance of the catastrophe one is in fear and trembling at every "seismotical" movement however slight, and "earthquake weather," as hazy calms are falsely called, invariably brings out its contingent of qualms and predictions.

The weather is no criterion whatever for anticipating these terrible visitors. During the seven odd years I have been in the "Fior' di Levante" I have felt at least eighty shocks, many of which were severe enough to crack plaster walls and send suspended articles dancing or falling about.

As a rule the shocks occur between midnight and daybreak; more frequently from autumn to early spring rather than in the long, hot, and dry summer. I have known them to shake us up during a heavy gale or in a perfectly dead calm, in a sultry night or in one of bitter coldness, but I have invariably observed that in proportion to the strength of the shock there has immediately followed a more or less radical change in the weather. On one occasion I remember that at midnight it was blowing a stifling scirocco. About four in the morning we had a smart shock of earthquake, and soon after we had a bitterly strong tramontana, with sleet, cutting one through to the bone. A shock during a fine, clear night will find us the next morning with a downpour of rain, and *vice versâ* a shock during bad weather brings us back the sun and cloudless skies. Even the other day when during a dead calm we smartly felt the shocks which destroyed Scio, an hour later a southerly gale of great force sprang up.

The most destructive earthquakes at Zante have invariably taken place in October. It was in this month some forty years ago that over 300 people were killed and wounded, and much property was destroyed, and in my time, viz., on the night of October 26th, 1873, a shock took place which threw down several houses and wounded a number of people. It literally cut the Eastern Company's cable between the island and the Morea.

From very authentic information I have been able to collect from a sixty years' English resident here (the late deeply lamented Mr. S. Barff) I find these shocks are undoubtedly stronger in proportion to the violence of the early autumn rains. From May to October rarely ever a drop of rain falls, but in the first fortnight of October the parched and cracked soil may, as a rule, be certain of having a thorough drenching. Often the rain, or rather the literal sheets of water, lasts for days, and when it has become well sodden in, and a fine day returns, a shock must, and invariably does, come.

Between 1873 and 1880 I have carefully noted this, and inasmuch as last summer was exceptionally dry and hot, we were all anticipating a severe autumn shock, the more so, because tradition asserts that Zante must be prepared for very big earthquakes every 30 or 40 years. Curiously enough, however, no rain fell here at all last autumn, and only two showers just before Christmas; the drought was excessively felt, and wells, which the oldest inhabitants never remember to have dried up, last winter gave in; consequently months passed without a single movement of the earth, and barring those shocks from Scio we have not felt one for many months past. This is a very remarkable fact, and undoubtedly confirms the opinion that the filtration of rain in large quantities acts explosively on the gases accumulated slightly below the hard baked surface.

That earthquakes are superficial, or at least have their origin but slightly below the earth's surface, seems proven by the fact that tall towers, &c., covering a comparatively small surface, never suffer at all; any buildings, however low they may be, if spread out are generally racked through and through.

In the south eastern corner of this island there is a small hill and village called Kiri, renowned for its pitch wells, and from which petroleum in small quantities has been extracted. There is nothing particularly interesting about these exhalations, except that the bituminous water, which bubbles up and oozes out, seems to be quite superficial, and it is asserted, and I believe fully confirmed, that previous to an earthquake the stream is stagnant and all movement ceases. It is generally understood that a violent shock repeats itself more or less strongly within twelve hours after the original one. This I do not find is invariable. However, we certainly did get the Scio shocks, one at 1:50 p.m. and another at 2 a.m.

From the most reliable accounts the number of victims at Scio was so great because the houses were not only lofty but also built of massive stone. Houses thus built are extremely dangerous; they should be elastic, and with as many windows and doors as possible, as it is found this special arrangement is the only one capable of breaking the strain on the entire building; and the rooms, too, should only be of a moderate size.

In the great earthquakes of 1866 at Cephalonia, Ithaca, and Santamaura the stone houses became one gigantic ruin, whilst houses lightly run up of stucco, plaster, or wood cracked and swayed about in all directions, but withstood the strain; basements slightly pyramidical in construction are, undoubtedly, a *sine qua non* for safety, as the old Venetian towers and forts thus built show no signs of ever having suffered, and the number of these fortresses is legion all over the districts already mentioned.

In Japan, where strong shocks are felt almost daily, I believe the houses are built without any foundation whatever, so that unless the earth opens and swallows up everything, the people and property appear to easily escape destruction.

The Japanese assert that just before a shock of earthquake takes place, and during the whole time it lasts, a magnet is either weakened, or momentarily loses, or reverses its polarity, and they ingeniously arrange a suspended magnet, with a weight attached slightly below its strength of attraction, over a metallic recipient, and they maintain that just before a shock the falling weight enables them to place themselves in a post of security. I have tried this plan, but am of opinion that the time a shock lasts is too short to ascertain whether the weight does not rather fall through the oscillatory, or is jerked off by the susultory wave.

I have never been fortunate enough to experience an earthquake whilst engaged in my cable-house testing the cables. On one occasion a smart shock took place shortly before I was ready to test, and on lighting up I found my galvanometer in a partial "fit," refusing to "come to," despite the most careful levelling, &c., and this lasted some considerable time—in fact, the astatic needles conducted themselves as if they had been acted upon by a thermo-current or the movement of some powerful magnet in their neighbourhood. All I know is I lost my test on that occasion, but on returning to the hut the following day everything went off perfectly OK. Some day I hope, however, to feel a good shock whilst a cable is under a test, and thus solve the important problem as to earthquakes being due to violent magnetic disturbances in opposition to the direction of the earth's polarity. That the too liberal use of electricity can have any influence on the earth's polarity, as a Yankee theory recently suggested in your columns, seems absurdly improbable; but that we are passing through a returned era of violent earthquakes seems undeniable. For some time past shocks have taken place in the most unexpected places, in Switzerland and Southern Austria for instance, whilst in others shocks are being felt where ages have passed since anything of the kind has been recorded, notably, both in Tuscany and Romagna, where shocks have lately been very frequent, and each one stronger or more varied than its predecessor. Scio was entirely destroyed in the third or fourth century. So also I find that Pistoja, the Val

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d'Arno, and many neighbouring parts were fearfully convulsed in the early part of the Christian Era.

Are we returning to this period?

Since writing the above I have perused in the *Engineer* the very interesting paper on earthquakes, submitted at a recent meeting of the Royal Society of Edinburgh, by Professor Geikei, on behalf of its author, Mr. C. A. Stevenson, and it is worthy of observation that many of my observations coincide exactly with his, although they have been made under entirely different circumstances, both of locality and climate.—Yours, &c.,

Zante. W. G. FORSTER.

"ARC *VERSUS* INCANDESCENT LIGHTING."

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I cannot help being gratified to notice that the conclusions to be drawn from your article bearing this title confirm the impressions suggested in my descriptive account of the City electric lights on the 1st April. This more especially with reference to the great lights, high lights, or whatever else they may be called, which dazzled but did *not* illuminate the open spaces. These were attempts at introducing arc lighting on a sensational scale, and they signally failed. There is nothing to be regretted in this failure, except the temporary disfigurement of three very fine sites, for the thing can be done handsomely and efficiently without any disfigurement at all. This is proved by the fact that the lanterns are now lowered to a third of their original height. I observe, too, that globes of ground glass have taken the place of plain glass. The general result is, far better light on the roadway where it is wanted, less shadow, diminished oscillation of the supports, and a light that one is not afraid to look at. Evidently, therefore, those semaphorial monstrosities were unnecessary; and I venture to say that posts of the ordinary kind and more of them would not only do the business quite as well, but would have an air of permanence which certainly nobody aware that there is such a thing as good taste even in the City of London could claim for the existing erections. I may also notice a circumstance bearing upon the advantages of numerous small lights. With the present arrangement foot passengers are recognisable so long as they are on the other side of the light, but directly they emerge on to your side, that is to say, get their backs to the light, they become the merest black shadows, the next light being too far off to reach them. Now, in a street well lighted with gas this is not the case; the gaslight is nowhere so good as the electric light where it *is* good; but where it is bad, as in the case just described, it is inferior to good gas-lighting. More lights and less glare is, I think, an arrangement that promoters of electric lighting should aim at. YOUR CORRESPONDENT.

May 9th, 1881.

TRANSPARENT SCALE.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Having just finished a reflecting galvanometer, and seeing in *Nature* Mr. Jacob's letter, I determined to try and make one according to his directions. The result, I am glad to say, has been a perfect success, the old sort of scale and screen not being able to "hold a candle to it." In the full glare of the sunlight the spot and line are perfectly distinct, and the ease with which it can be read, especially with the aid of a hand lens, makes one bless the inventor. I find a good plan is to completely box the lamp in, leaving only the slit and wire through which the light can travel, and by the use of a small circular mirror, mounted on an ordinary universal jointed stand (such as is used for a microscope condenser), the beam of light can be directed straight on to the galvo-mirror without the mirror stand obstructing the ray from reaching the scale. The lamp is placed at the end of the screen, the light issuing parallel to the scale.

The account given in the last number of *The Electrician* of Faure's Secondary Battery is not quite lucid enough to enable me to construct one. Where could I obtain fuller directions, as I should much like to make one of these useful batteries?—Yours, &c., J. KENNETH D. MACKENZIE.

Elswick Ordnance Works, Newcastle-on-Tyne,
May 7th, 1881.

THE PERTURBATIONS OF TELEPHONY.

An investigation of some importance to those engaged in telephony has been recently made by M. Gaiffe, the well-known French electrician. He has endeavoured to prove whether or not the extraneous disturbances or sounds of unknown origin heard on telephone lines along with the transmitted speech are not due to causes which oppose telephonic transmission to a great distance.

In order to eliminate sources of error, M. Gaiffe arranged the apparatus of his experiments as follows:—The line, which had a length of about 20 metres, was laid along the floor of several rooms, opening into one another. It was connected at one end to a pair of telephones by means of flexible conductors designed to arrest any sounds which might have propagated themselves mechanically across rigid metal to the telephones. For additional precaution the circuit was completed between these by another flexible wire, including a circuit breaker, by which the circuit could be interrupted without disturbing the apparatus, so as to show if the noises had an electric origin. The operator acted directly at the other end of the line which was not connected either directly or by induction with any electric generator.

M. Gaiffe soon observed that the current generated by the rubbing together of two wires either of one or two different metals, or that produced by the friction of a binding screw connecting two parts of a wire, was heard in the telephones. In order to intensify the effect it was sufficient to connect one of the line wires to a file and the other to a metal point, and then to draw the stem across the file. The grating sound of the point on the file could then be very distinctly heard in the telephone.

It can readily be understood that when aerial telegraph lines serve for telephonic transmission the first cause will be sufficient to generate disturbances, since these lines are formed of wires jointed with screws, and more or less imperfect ligatures which are in a continual state of agitation. But this cause of non-success could be overcome by replacing these simple ligatures by soldered joints.

Unfortunately there exists a more grave cause in the currents generated by the mere existence of the vibrations themselves. These currents were surmised by M. Gaiffe from *a priori* reasoning, and to verify his hypothesis he placed in the circuit at the extremity of the line opposed to the telephones, a strip of iron about 1·50 metres long, connected to the telephonic system by flexible conductors incapable of transmitting mechanically the vibrations of the strip to the telephones. On striking this iron strip or rod, sometimes transversely, sometimes longitudinally, the sounds determined by the shocks were reproduced in the telephones.

This experiment repeated with rods of copper and iron only gave negative results. The phenomenon seems only to appear when the rod is of iron. Is it due to the molecular changes experienced by the metal or to some particular inductive action? Succeeding experiments by M. Gaiffe will, it is to be hoped, answer this question.

If, as is probable, the vibrations set up in the wires by the wind act like the shocks on the rod in question, it will be seen that the longer the line the more difficult it will be for telephonic messages to reach their destination in an audible form, owing to the fact that the shaking of the wire by the wind will, as it were, obliterate vocal currents.

These results of M. Gaiffe have brought to light a new source of electric disturbance on telephone lines. Hitherto it has always been supposed that the induction of neighbouring wires was the only cause of disturbance, but he has proved that the very vibration of the wires in the wind has the effect of generating currents which on a long wire at least may seriously interfere with the transmission of a telephonic message. The whole atmosphere is a magnetic medium through which the aerial lines are suspended, and the swinging or oscillation of the wire either bodily or molecularly when under the influence of a shock, generates currents in it which destroy the distinctive character of the message. Professor Hughes has lately shown that a current traversing an iron wire actually twists it, and that this twist can be neutralised by an opposite twist mechanically given to the wire. It is probable, therefore, as Mr. J. Munro has pointed out, that the twisting and straining action of the wind on a telegraph wire while the telephonic current is passing may tend to neutralise, and so to speak, blurr the vocal currents. Torsion of the wires, as well as mere vibration, may operate against the transmission of telephonic currents on long lines.

Two remedies, however, suggest themselves for this evil. One is to abandon aerial lines in favour of underground ones, and the other is to employ wires of some non-magnetic metal. Copper might be employed if it were stronger, brass would answer better, but manganese bronze would, probably, succeed best of all. The matter is one requiring the consideration of all who intend to employ the telephone over long distances. Underground wires are, of course, free from the shaking of the wind, and they have other advantages in their favour, but for long lines they are expensive, and the retarding effect of induction comes into play upon them, as it does on submarine cables. The latter evil would probably on a line of 100 miles prove far more obliterative to the telephonic message than molecular disturbance. Perhaps the further experiments by M. Gaiffe will help to suggest a remedy.

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THE ELECTRICIAN.

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THE TELEGRAPH AND LIGHTSHIPS.

The feelings of satisfaction with which we welcome the movement now being seriously set on foot for establishing electrical communication between lightships and the shore are, it must be confessed, not unmixed with shame that a project obviously so desirable, and seemingly so simple, still remains to be carried out. Probably the history of lighthouses and lightships is as much tinged with selfishness as most other histories, the beacon on Pharos Island and the towers of Sestos and Abydos being more for the purpose of inviting commerce into special ports than to help the mariner to steer his way elsewhither in safety. The spirit which prompted the ancient depôts of merchandise descended through many centuries to the several maritime nations of modern Europe, limiting their objects mainly to the interests of their own trade rather than to the safety of navigation in general. But in more recent times a juster appreciation of their true interests and a more benevolent interpretation of international obligations have prevailed. There are few points of dangerous coast, either of rock or shallow, belonging to civilised communities that are not now sufficiently marked for all alike, and for humanity's sake as much as for gain. Lightships are at once the most modern and the most numerous of these warning signals, and no country has provided them more bountifully than we have done. The protection they actually afford has no record except in the growth of our trade and the increased hospitality of our ports. But the catastrophes they are unable to avert are brought home to us now and again by the harrowing story of some tempest tossed vessel being driven helplessly where the Fates have doomed it, and when no effort of mortals can divert its course. But then, when a lightship can do nothing to prevent, is the the very moment it ought to be able to do something to mitigate, the horrors that must ensue. It is for occasions of this sort that intelligible communication with the shore is most needed, and the establishment of which would often be the means of bringing assistance now only too often forthcoming when all is too late.

Private philanthropy, which has established and maintained the lifeboat service all round the extended seaboard of these islands, is now again being roused to complete their usefulness at times when ordinary signalling is of no avail. There are plenty of lookouts on all dangerous coasts, and how frequently their services are called into action everybody knows who has spent any portion of their lives at the seaside. But they know, also, too painfully that many are the times when fogs, sleet, rain, or intense darkness at night will render outlooks practically useless, even though help could safely be sent if the need for it were certainly known. To the scene of a wreck one lightship or another is pretty sure to be within sight, but it cannot itself give assistance, nor can it obtain help from shore. The solitary occupants of the humanely-devised beacon are consequently compelled to be mere spectators of a tragedy the prevention of which is the one main object of their isolation. These painful incidents are by no means rare, and it is to render them more infrequent as well as to serve many useful, if less urgent purposes, that the promoters of the petition we print in another column have commenced their praiseworthy agitation. We sincerely wish it success, and we certainly think that the experiment should be tried; but it is perhaps only natural that the benevolent promoters of the scheme should underestimate some of the difficulties which at once present themselves to practical minds.

The petitioners ask why should the stations of the Fire Brigade be connected by telegraph, chiefly in order to protect property, when lightships remain severed from each other and from the shore, though human life is here always at stake. The obvious answer is, because the connection in the one case is easy, whilst in the other its establishment would be costly and its maintenance very far from certain. The uncertainty is, apart from its cost, probably the chief hindrance to the connection being speedily effected. We may almost take it for granted that so soon as public attention is persuaded to consider the subject the expense will not stand in the way of a trial, if only some reliance can be placed upon the means of communication being reasonably permanent. Very wisely, we think, the scheme at present only contemplates the connection of two or three of the more notoriously dangerous shallows or sandbanks with shore, leaving the rest for time and experience to develop. There should be no obstacle to the laying of experimental short cables to these points, either too thick to be easily disabled or so light as to be picked up or sacrificed at comparatively little cost. But the real difficulty has hitherto been the connection with the ship itself. The problem of attaching a telegraph cable to an object continually in

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motion, and shifting its position very frequently, is by no means an easy one. Fouling the anchor cable has to be guarded against, whilst the risk of a kink in the necessary amount of slack for such a situation is very considerable. Since the Wreck Commissioners' recent report on this subject attention has been given to these points, and we are glad to learn that mechanism has been devised and patented which promises to overcome the difficulties to which we have referred. We hope to be able shortly to give a detailed description of the arrangement, which affords another illustration of the fact that so soon as public opinion demands an invention the inventor is not far to seek. And in this instance, if the connection of lightships with the shore can be proved to be as practicable as it is desirable, we are sure the public would subscribe the necessary funds even if the Board of Trade failed in its endeavour to obtain them from Parliament.

THE FUTURE DEVELOPMENT OF ELECTRICAL APPLIANCES.*

BY PROFESSOR JOHN PERRY, B.E., ASSOC. M.I.C.E.

(CONCLUDED FROM PAGE 313.)

Another application of the principle of recurrent effects, which may, indeed, be regarded as the earliest of such applications, is this multiple telegraph of Mr Elisha Gray, which my friend Mr. Graham has been kind enough to put in working order, so that it may be worked from this table to the telephones hanging against that wall. About this telegraph, which allows a great number of messages to be sent through an ordinary telegraph wire at the same time, Sir William Thomson wrote to me in terms of high eulogium when he first examined it at Philadelphia. At present I believe that the quadruplex system is more favourably looked upon, because it has succeeded better in practice, but I am inclined to think that in the distant future it may possibly have enormous development.

In this paper I wish I could bring in, as illustrations of the few great principles which are really the important factors in the future development of electrical appliances, the microphone and all the instruments which have been derived from it, but even to refer to them would take far too much time. I would end by speaking of two appliances which are of quite a different species, namely, Mr. Edward Bright's method of de-electrifying woollen yarn, and of a contrivance for seeing by electricity. In the manufacture, the woollen yarn becomes electrified by friction, and has hitherto lost its electricity very slowly, requiring to be stored for many months in damp cellars before it got rid of its electricity. Until lately, nobody seems to have suspected that it was electricity which caused the fibres to stick out on all sides of the yarn instead of staying in an interlaced condition. It was found to occur most in dry weather, and was vaguely put down by Englishmen to "the weather." So very annoying was this in a dry climate, that although Bradford men and Bradford machines were taken to America, only two months in the year could really be devoted to the manufacture. Now, we have here some woolstaple in the air which is being electrified by this plate machine. You see how the fibres repel one another and remain in this state. You observe, however, that these other fibres we try vainly to electrify because they are in a partial vacuum, and electricity escapes from them as rapidly as it is formed. I will allow air to enter this air-pump receiver, and now, when the machine is worked, you see (experiment shown) that these fibres retain their electricity. The principle that a partial vacuum is very conductive has long been known to electricians, but the remarkable saving in woollen manufacture effected by applying a knowledge of the principle was left for Mr. Bright. Mr. Bright's plan of operations is to have chambers where partial vacua may be produced. He wheels large trucks of electrified bobbins of yarn into these chambers, and takes them out very soon, unelectrified, thus performing, in a few minutes, an operation that used to be badly performed, in a costly manner, in half a year. Can we doubt that, when boys obtain, in all elementary schools, a knowledge of electricity, there will be rapid additions to the number of electrical appliances?

And now let me come to the last of the developments of electrical appliances, still perhaps somewhat in the future. A picture in *Punch* of an aged couple at home seeing on their drawing-room wall an image of their children playing lawn-tennis out in India, and of their conversing with some of them by telephone, first led Mr. Ayrton and myself to think of this matter. We showed that it was feasible, in a letter to *Nature*, and in *The Times* about a year ago. The feasibility of the method described by us was doubted, and we therefore proved it at a meeting of the Physical Society four weeks ago. I mean to put it before you in a slightly different form. Suppose that place is York, and this is London. I have a little selenium cell at York on a certain part of this picture, and at London I can throw at a corresponding place on this screen a square of light; and suppose that the illumination of this square is governed by a little movable shutter which is attached to the needle of a galvanometer. Now, when light falls on the selenium at York, an immediate change occurs in it, so that more current flows to London, and this opens the shutter. The London square is then bright, when the York selenium is in bright illumination. When the York selenium is in shade or darkness, you see that the London square is in corresponding shade or darkness. (Experiment shown.) Now, suppose that we form an image of this girl with her skipping rope at York, and cause a selenium cell at York to travel across her image, and suppose that this mirror at London moves so as to cause the illumination which passes the shutter to traverse this London screen isochronously—an operation performed in several telegraph instruments. Then whenever this cell reaches a dark, or shady, or bright place in the image at York, there will be darkness, or shade, or brightness at the corresponding place in London. And now suppose that this motion is effected rapidly enough, you are all aware that if the shutter is only quick enough in its answering motions, the image of the part of the screen at York traversed by the cell will be faithfully reproduced, and will remain on the retina at London as a distinct picture in black, and grey, and white, just like a photograph. With then, perhaps, forty such cells as this, all moving in the way spoken of, or a smaller number rotating on a radial arm, it would actually be possible to show at London, not merely an image of a girl at York, but an image of a girl skipping. You will, perhaps, better understand this principle from the model. Here is a path of black and white spaces at York, over which this selenium cell is made to travel. We have continued the images to the paper above, simply to let you know when the cell is in the image of a dark place, and when it is in the image of a bright place, so that you may be able to say whether there is a faithful reproduction at London. These two frames are really tied together by this long string to make them move isochronously. In practice, I need hardly say that this function will be performed in another but quite as feasible a manner.

The cell at York is in a black part of the picture; you observe no light on that part of the screen in London. The cell at York is in a bright part of the picture; the corresponding part of the screen at London is bright. And so we find that, as the cell goes successively through dark and bright places, so the corresponding parts of the screen at London are made dark and bright. (Experiment shown.) Our shutter is not yet sufficiently dead-beat for us to make this motion rapidly.*

I had hoped to be able to show you to-night the development of this method, by using what we have called the Japanese-mirror principle. We have shown† that the most minute effects on the backs of metal mirrors, effects quite invisible when examining the polished surface of the mirror, are very visible in the reflection of a divergent beam of light. Such effects, we believe, we can produce by electro-magnets arranged radially behind a circular mirror and rotating with it. This radial arrangement of magnets will move synchronously with a radial arrangement of corresponding cells. The principle, however, is exactly the same as that shown by this model, only we know that the change of curvature at a point in a mirror will obey changes of magnetic effects more rapidly than this shutter does.

I had hoped to be able to present to you the scheme, which Mr. Shelford Bidwell has proved to be feasible, of reproducing in shaded lines on paper, by electro-chemical decomposition, a picture of a distant stationary object. I understand, however, that Mr. Bidwell has been asked to read a paper here, when he will exhibit the model he has made.

In my paper read here a year ago it was the importance of giving artisans facilities for obtaining practically exact knowledge in science that I especially laid stress on. To-night I have desired, first, to show what benefits our country would receive from an exact knowledge of electrical magnitudes, and of the fundamental laws of electricity being more widely disseminated, and, second, how the principle of recurrent effects may be employed to assist our senses.

* Paper read before the Applied Chemistry and Physics Section of the Society of Arts on March 24th, 1881.

* After the reading of the paper it was found that even with the shutter it was nearly possible to make the motion fast enough for the retention by the retina of a complete image of the path traversed.

† See *Proceedings of Royal Society*, No. 191, p. 127, 1878.

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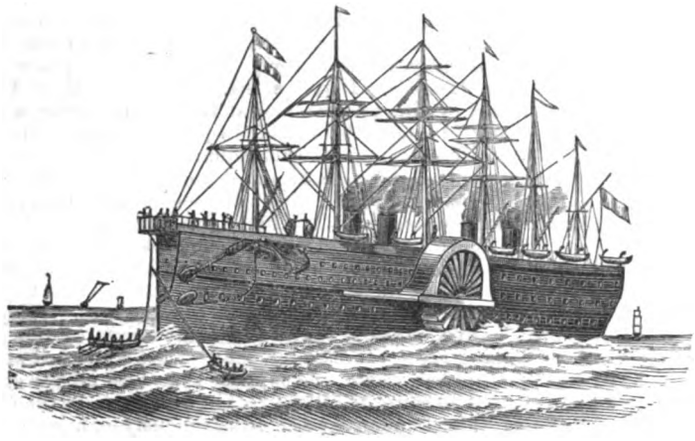
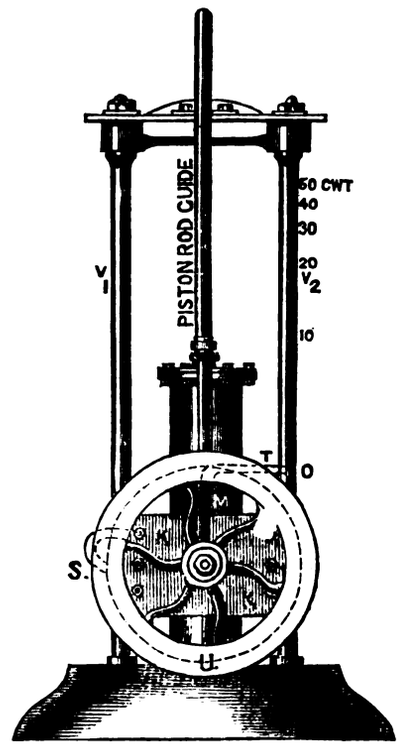
LAYING AND REPAIRING SUBMARINE TELEGRAPH CABLES.* By A. Jamieson, C.E.—(*Concluded from p.* 323.)



Great Eastern.

Dynamometer.



Fig

Lucass Nipper

A

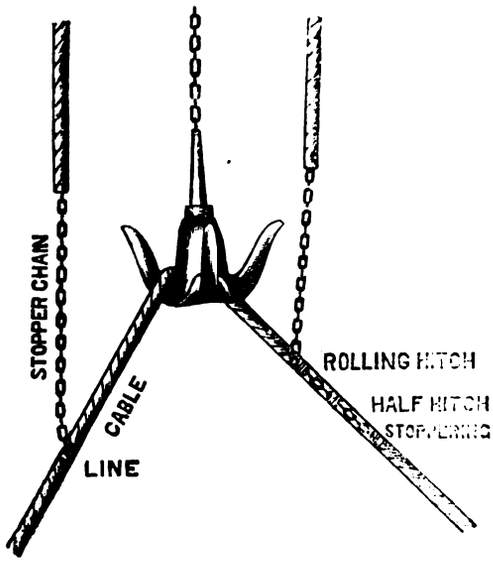
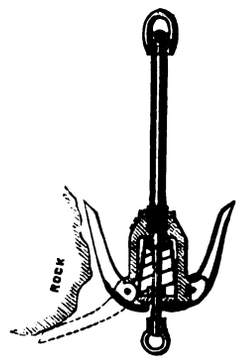


Fig.



Jamieso Grapnel.

Dynamometer

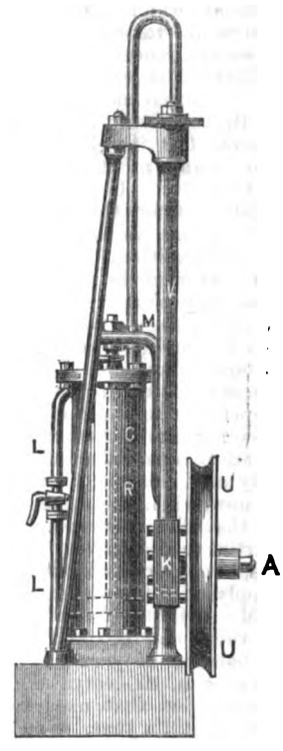
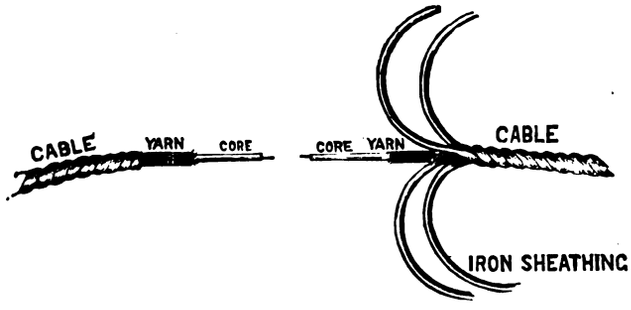


Fig. 3.



Let us now turn our attention to the different kinds of grapnels, ropes, &c., that have been devised for hooking and lifting submarine cables under different circumstances.

The accompanying Fig. A shows the method of stoppering previously referred to, and Fig. B the manner of splicing, while we give a small illustration of the celebrated "Great Eastern" steam ship, a large picture of which was shown, by the kindness of Sir J. Anderson, on the wall of the room in which the lecture was delivered.

* A Lecture delivered at the Naval and Marine Engineering Exhibition, Glasgow, January 28, 1881.

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The first kind of grapnel used, and often used still, is that known as the long-shanked five-pronged grapnel, of which Fig. 6 is a sketch. The prongs and shank are all rigidly welded together, the shank being about 4½ft. long, with a swivel end.

Another and now more commonly used form is that known as the "Centipede Grapnel." It consists of a *square* bar of iron with a ring fixed at each end, and a series of double prongs wedged into holes in the shank. This form of grapnel has two or three advantages over the five-pronged one. The prongs can be removed and others refixed on board ship without the difficulties of welding, it is easier to make, it affords a double chance of catching the cable (that is to say, should the front toes miss, those behind may still catch the cable), and it can be furnished with a trail chain or weight attached to the after ring bolt to prevent jumping.

Both these forms of grapnel, however, labour under the disadvantage that, if once engaged with rocks or other fixed obstacles, the greatest difficulty is experienced in relieving them without breaking the toes or some part of the grapnel system, either rendering grapnel useless for further work, and necessitating its being elevated on board ship, and a fresh one attached, lowering the same, and commencing the work over again; or, in the case of the grapnel rope giving way, losing part of the rope chain and grapnel. A kind of centipede may be used at a push, by employing a large chain, with bars inserted in the centre of the eyes of the chain, as seen in the sketch. This proves a serviceable grapnel of the non-relieving type.

While repairing the Para-Pernambuco section in December, 1875, we experienced an immense deal of trouble from this cause, owing to the very hard rocky bottom there; and it occurred to me then that a grapnel might be constructed with self-relieving toes, so as to give way when engaged with rocks, but so constructed that the toes should automatically assume their normal working position immediately after slipping over the rocks. I mentioned my idea to Mr. Wm. F. King, Engineer-in-Chief to the Western and Brazilian Telegraph Company, and we designed a form of grapnel to effect this object. On returning to England, I carried out several improvements, with the able assistance of Mr. Alexander Glegg, the maker.

Here is a full-sized working grapnel before you, sent here by Sir James Anderson for exhibition, along with some other interesting things which I have shown you, and here is the model. I will now show it in action upon those miniature rocks.

This grapnel permits of working on rocky or even ground without fear of sticking, at the same time affording every facility for catching the cable and retaining the same when caught, as well as preventing the sharp nip caused by ordinary grapnels, by having broad, well-rounded shoulders, upon which the cable may rest when being elevated to the surface.

The accompanying drawing, Fig. I, represents a sectional elevation of the improved grapnel. There is the shank of the grapnel; with the cylindrical boss, which may be made of cast steel, malleable iron, bronze, cast iron, or other suitable material, and which contains and protects the spring; this spring may be constructed on the volute, spiral, or any other principle, and may be made of steel, india rubber, or both combined—a volute spring being preferred. Round the lower end of the boss, project toes or prongs, which are cast or otherwise, formed solid with the boss, each pair of toes embracing a much longer toe, by preference composed of wrought iron or steel, which is held in position by a fulcrum pin, round which it is capable of revolving. The shank, which has attached to its upper end a shackle provided with a swivel joint, is firmly screwed to the boss by a long coarse pitched thread, secured by a jam nut and clamp plate in any desired position; the diameter of the shank is then reduced, as shown, and the reduced portion passes down through the boss, and terminates in a screwed end, to which is attached the shackle for the "trail" chain. There is a movable piston, capable of sliding up the reduced portion of the shank.

The apparatus operates in the following manner:—The toes when engaged by rocks or other obstacles are pressed outwards, and rotate round their respective fulcra, their inner ends bearing and pressing against the movable piston, which travels up the reduced portion of the shank, within the boss, compressing the spring; this movement may continue until the toes move round to the angle shown by dotted lines on the left hand side of figure, which position is amply sufficient to relieve the toes from any rock or other obstacle. As soon as the toes are released, the piston is forced down under the action of the spring, and in its turn acts upon the toes, thereby restoring them to their working angle; this angle is fixed by shoulders on the boss, which form stops between the boss and the toes.

By fixing the shank to the boss the toes always maintain the working angle, unless engaged with rocks or other obstructions, and the initial tension may be increased or diminished by screwing down or up the shank or other adjusting nut or gland in the boss. The grapnel can be taken to pieces and put together again in twenty minutes.

This grapnel has already proved of good service in repairing cables in South America, under the skilful management of Mr. King, and has been adopted by the Eastern Telegraph Company, and other companies are also making inquiries about it.

The saving in time alone effected by not having to elevate the grapnel to the surface for inspection or renewal will be found to more than repay its extra cost in a single expedition.

Grapnels are and have been used with provision for removing the toes when they become broken, but this necessitates their elevation to the surface every time a toe gets bent or broken, and it just takes as much time to insert a fresh toe as it does to attach a new grapnel, the only gain being a saving of expense in fixing the toes.

For very deep sea work, where the depth and corresponding slack will not permit of the cable being elevated on the bight, owing to the strain, &c., grapnels have been specially designed, as I mentioned before, for cutting one side and holding on to the other until it is brought to the surface.

We have, I think, now spoken of all the kinds of grapnels commonly in use, except to say that sometimes the cable is brought up upon the shackle pin. I have seen this occur three different times, and it was only the other day, 15th February last, that we brought up the cable, from 800 fathoms water, on the shackle pin next the grapnel. This arises from placing the shackle with the curved part towards the grapnel rope instead of the other way, when it could not possibly catch the cable.

There is nothing particular to remark about the grapnel chain. It simply requires to be of good material, with well made free and easy working links that won't jam or become entangled, and being of ¾ or ⅞ inch iron leaves a large margin of safety strength over that of the grapnel rope used. There are two plans of fixing, one has the disadvantage of a projecting eye, which is apt to foul the rope passing over the drum, and requires to be bound to the body of the shackle with wire seizing, which runs a chance of becoming loose or worn through on the ground, allowing the bolt to turn and slip out. Instead of wire fastening, the bolt may be secured by a set screw, and the bolt itself screwed home by screw driver, which necessitates a T screw driver to be always at hand when it is required to fix or unloose this form of shackle. Upon the whole, plan A is preferable to B, as it presents no obstacles to passing clear. Grapnel ropes as fitted in various lengths, 200, 100, 50, and 25 fathoms; at one end of each length is spliced an oblong link and thimble, at the other end a thimble swivel and link. The object of the swivel is to relieve the rope from kinking and taking turns in it. The reason for having the grapnel rope in stated lengths is to facilitate uniformity, and admit of knowing the length out without referring to the rotometer for buoying purposes, &c.

The grapnel rope most commonly used is that known as 4 by 4. It consists of 16 steel wires, No. 13 Birmingham gauge, each wire being served with 5 or 7 well tarred manilla strands, four of these manilla served wires being stranded together, and the 4 strands laid up into one rope. This rope should bear a strain of 15 tons without breaking, and be of the very best material, but as a rule it is not considered safe to tax its strength beyond 10 tons, and I have seen it go at 5 tons; 6 by 6 (that is a rope made of 36 steel wires and manilla strands in exactly the same way as the 4 by 4, with 6 strands instead of 4) is sometimes used in shallow waters, with the centipede or fixed toed grapnel, where heavy and sudden strains, as well as chafing, are expected, but it is not required with the self-relieving grapnel, and from its great weight is impracticable in deep water; 6 by 3 is a good rope, and coming into favour; 3 by 3 is too light and weak for ordinary grappling, and is only used for a buoy rope. *White or untarred manilla* does not answer well when laid up with steel wires to form a grapnel rope. It absorbs water and tends to kink, coiling badly after use, causing great trouble in paying it out a second time; besides, its co-efficient of friction is small, and it slips on the drum of the picking-up gear.

When grappling in deep water, say over 1,000 fathoms, steel wire manilla ropes are disadvantageous, owing to their weight. A 4 by 4 rope, working in 2,000 fathoms, raises the normal or working strain on the dynamometer between 65 and 70 cwt., lessening the sensitiveness of feeling and observation. I understand that pure manilla was successfully used by the Telegraph Construction and Maintenance Company in the Atlantic repairs, and that with 500 fathoms of 6 by 3 steel wire manilla next the grapnel, and 2,000 fathoms manilla rope, the normal strain was only from 40 to 50 cwt., where, had 6 by 3 been used throughout, the normal strain would have been nearly 80 cwt. This certainly is a great improvement, as it affords much greater

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facilities for ascertaining when the cable is hooked, besides permitting of buoying the bight on an emergency with a buoy of smaller capacity, and lessening the working strain of the whole grapnel system. As a comparison between the two systems, we might cite that of bait and fly fishing. In the one case we have a dull, heavy line, with lead sinker; in the other a fine, flexible, and light but strong cast, giving warning of the slightest nibble. Another strong proof of the advantages of the manilla rope for deep-water work is that no rope was lost in the late Atlantic repairs, although the strain sometimes reached 9 tons. Some further details of this manilla rope and its behaviour, as well as the best mode of handling it, would be most instructive and interesting from those who used it. Lightness combined with sufficient strength is a matter of great importance, and the manilla rope bids fair to be the grapnel rope of the future for deep-water work.

Every repairing ship should be furnished with three bow sheaves, the centre one for grappling, and those on either side for paying out or picking up, as the case may be, when the cable has been brought to the bows. Two are bad enough, and one is a nuisance, from the time spent in fixing ropes and stoppers.

The bow baulks should stand well out beyond the bows of the ship, allowing the grapnel rope to clear the forefoot without heaving in the rope or backing the ship when it is required to change her course. They should be covered in flush between the iron girders with wood, and be supplied with two or three sets of stopper hooks, in order to admit of relieving the strain from the picking-up gear when it is required to change the rope or shackle on a new length. This reminds me that the fewer the shackles employed in a grapnel rope the better, provided the whole length is of the standard strength, as every time a shackle passes the bow baulks, dynamometer, and picking-up gear, care has to be taken that it does not foul.

The dynamometer, Figs. 2 and 3, at present in use consists of a piston-rod (R), with piston P working in a bored cylinder (C), filled with water or oil. The cylinder has a small pipe (L) communicating with the top and bottom, to permit of the liquid passing below or above the piston as it rises or falls with the strain. To the top of the piston-rod is fixed a connecting rod, M, with cross-head guide, K, working between vertical parallel columns, V_1 V_2, and to this guide is attached the dynamometer pulley U, which runs loose on its axle (A). S is a scraper to keep pulley V clean and clear from tar, pitch, and dirt from cable. Provision is generally made so that a number of extra weights may be attached to the piston rod or pulley to increase the apparent sensitiveness of the dynamometer when working in deep water or where heavy strains occur. The crosshead K carries a pointer, T, which indicates on a scale (suitably marked in cwts.) attached to the framing or guides of the dynamometer the strain brought to bear on the grapnel rope or cable.

The scale may be marked off by calculation according to the following formula, but should also be verified by a practical test, as the rule does not take friction into account.

Referring to the diagram, let B C indicate the centre line of dynamometer placed midway between centres of the picking-up drum A and fair lead pulley D.

Let W = weight of dynamometer pulley, crosshead, &c., in cwts.

S = strain on cable or rope *(to be found)* in cwts.

BC = deflection in inches of rope or cable at point C from straight line between A and D.

AB = distance in inches between centre lines of picking-up drum and dynamometer.

Then completing the parallelogram of forces, that is drawing AE parallel to CD, and DE parallel to CA, and projecting CB to E, we see at once that CA represents the strain S, to the same scale that CE represent the resultant or W.

$$\therefore \text{CE} : \text{C A} :: \text{W} : \text{S}; \text{ but C E} = 2\text{ B C and C A} = \sqrt{\text{A B}^2+\text{B C}^2} \therefore \text{substituting } 2\text{ B C} : \sqrt{\text{A B}^2+\text{B C}^2} :: \text{W} : \text{S}$$

$$\text{or S (strain on rope)} = \frac{\text{W}\sqrt{\text{A B}^2+\text{B C}^2}}{2\text{ B C}}.$$

It will also be seen from the formula that the strains and deflections of the dynamometer are in inverse ratio to one another, so nearly that having marked the scale for one strain, the position of the others may at once be found without working out the whole formula for each strain or deflection.

The foregoing form of dynamometer gives a fair idea of the strain, when the grapnel rope or cable is *static*, that is not being picked up or payed out, but it does not account for speed or rate of these operations.

The picking up gear has received very little improvement within the last ten or fifteen years, although there are several deficiencies or apparent drawbacks in its arrangement and manufacture. It consists of a pair of horizontal steam engines with fast and slow gearing revolving a drum round which the cable is coiled three or four times, having break gear attached to the second motion, worked by screw and handle.

In the first place it is very heavy and clumsy, and stands much in the way of the work, and would be handier if the engines and drums were placed on the main deck instead of as at present on the upper deck, and only the tops of the drums above, like the ss. Scotia. Secondly, the gearing is not sufficiently protected from fouling the cable. Thirdly, there is no provision made for automatically acting breaks, to permit of long lengths of cables being paid out over the bows. Fourthly, it should have two overhanging drums, working conjointly, or independent of each other with means of paying out one side while packing up the other when the cable has been cut, instead of having recourse to the steam winch, capstan, or bullards, and admit of putting on or taking off the grapnel rope or cable at any moment, without having to wait until a shackle passes or cutting the cable, or, in other words, duplex gear. Fifthly, steam of sufficient pressure and quantity should be supplied from a separate boiler, and not be dependent upon the main boilers of the ship. Sixthly, all handles for starting and stopping the gear should be brought to one platform, and so arranged that they may be manipulated with ease and without loss of time. Seventhly, a perfect system of telegraph communication should be fitted between the gear bow baulks, and tanks, so that the attendant may not be continually on the strain for a shout or whistle. All these are retirements which the picking up gear of a repairing ship should have, but which unfortunately they don't as a rule possess.

Such are a few of the chief points connected with the laying and repairing of submarine telegraph cables. I hope what I have said has been made sufficiently clear by the assistance of these large drawings and models, so that should you read in the daily papers of a cable expedition being started to connect this and that outlandish place, or should you hear of one of the Atlantic cables being down, you will now have a more exact idea of the engineering difficulties that arise and how they are overcome.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.

Report of the directors to be presented at the fifteenth half-yearly general meeting, 20th May, 1881:—The directors will submit the accounts and balance sheet for the half year ended 31st December, 1880. The revenue for this period amounted to £82,084 6s. 0d.; the working expenses to £11,743 18s. 0d., leaving a balance of £70,340 8s. 0d.; to this is added £4,103 17s. 11d., brought forward from the 30th June, 1880, making a total of £74,444 5s. 11d. After deducting income-tax, £1,133 10s. 2d., there remains a balance of £73,310 15s. 9d. First and second interim dividends amounting to £39,000 have been distributed, leaving the sum of £34,310 15s. 9d. to be carried forward. The Company's cables continue in good working order. The directors have considered it desirable to establish an assurance fund to enable the staff to secure the payment of a limited sum to themselves at a fixed age, or to their families in case of their death, the Company paying one half of the requisite premium. A resolution empowering the directors to carry out the above arrangement will be submitted to the shareholders; the estimated cost to the company is about £800 per annum. This system of assurance has been adopted by the principal telegraph companies.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices May 11.		Business Done Week Ending May 11. Highest.	Lowest.
Anglo-American	56¼,	57	57	55
Do. Preferred	87,	88	87½	85½
Do. Deferred	28½,	29	29½	28½
Brazil Submarine	10¼,	⅛	10⅛	10⅛
Cuba	9,	⅛	9 3-16	9⅛
Do. Preference	16½,	17	—	—
Direct Spanish	3½,	4¼	4	4
Do. Preference	13.	14	—	—
Direct United States Cable	11¼,	⅛	11¼	11
Eastern Telegraph	9¼,	10½	10⅛	9⅛
Do. 6 per Cent. Preference	12½,	13	13	12½
Do. 5 per Cent. Debentures, 1899	105,	108	105	105
Eastern Extension	11,	¼	11¼	11¼
German Union	11½,	12	12	11½
Globe Telegraph and Trust Company.	6½,	⅛	6 9-16	6½
Do. Preference	12½,	⅛	12½	12½
Great Northern	12¼,	13½	13	12½
Indo-European	29,	30	29½	29½
Mediterranean Extension	2½,	⅛	2½	2½
Do. Preference	9½,	10½	—	—
Reuter's	11,	12	11½	11½
Submarine	270,	290	—	—
West India and Panama	2,	¼	2½	2
Do. 1st Preference	7,	¼	7 1-16	7
Western Brazilian	8½,	⅛	8½	8½
West. Union 7 per Cent. 1st Mortgage	120,	125	—	—
Do. 6 per Cent. Sterling Bonds	104,	108	—	—

THE BRAZILIAN SUBMARINE TELEGRAPH COMPANY (Limited).—NOTICE is hereby given, that the FIFTEENTH HALF-YEARLY GENERAL MEETING of the BRAZILIAN SUBMARINE TELEGRAPH COMPANY (Limited), will be held at the CANNON-STREET HOTEL, LONDON, E.C., on FRIDAY, the 20th day of May, 1881, at half-past 1 o'clock in the afternoon, to receive a Report and Accounts from the Directors.

By order, RICHARD COLLETT, Secretary.

8, Great Winchester-street, London, E.C., 11th May, 1881.

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ABSTRACTS OF SPECIFICATIONS.

3637. IMPROVEMENTS IN ELECTRIC LIGHTING, *P. M. Justice.—Dated 7th September*, 1880.—(*A communication from H. C. Spalding.*) 6*d*.

The object of the invention is to avoid shadows cast by buildings, &c. To obviate these the inventor employs groups of electric lights, erected on towers from 100ft. to 200ft. high, so that the light may be about 100ft. above the houses. These towers are arranged in triangular groups of not less than three towers, whereby the rays of light cast from one tower cross those cast by the others angularly. Each tower supports an electric light lantern consisting of a gallery or floor, surrounded by glass and enclosing the lights massed in a circular group, surrounding and external to the frame of the tower, so that it casts no shadow. That no light may be lost by upward radiation, each group is surmounted by a circular or conical reflector projecting beyond the groups. To protect the lantern and reflector from the weather, they are surmounted by a conical roof.

3648. COMBINED LAMP AND TIME INDICATOR, *F. M. Robertson and J. Joyce.—Dated 8th September*, 1880. 6*d*.

The varying level of the oil used for producing the light is utilised to actuate the time indicating mechanism; and also, when desired, to ring an electric bell and warm food. The oil reservoir contains a float to which a rod is attached, such rod having teeth to gear with a wheel on the shaft carrying the hands, which moves over a clock dial. To ring the bell the hand at the desired time is caused to bear upon a pin, and so complete an electric circuit in which is a bell.

3784. ELECTRIC TYPE PRINTING TELEGRAPH APPARATUS, *G. J. Droste.—Dated 18th September*, 1880. 10*d*.

This apparatus belongs to that class of type printing telegraphs in which by continuous contact closings and interruptions of the line current passing through the electro-magnets of the instrument in connection, the type disc is moved round from letter to letter, until the type of the letter to be telegraphed stands opposite the printing appliance, which, when put into action, prints it on a paper band. The inventor makes eighteen claims and illustrates by intricate drawings.

3808. DYNAMO MACHINES, *F. G. Willatt.—Dated 20th September*, 1880.—(*Not proceeded with*). 2*d*.

An armature is cast in one solid piece having four or more, but preferably six blades, broad at the end and narrowing somewhat towards the centre. Each blade is wound in the same direction and coupled up so as to form north and south poles across the centre of the armature when in motion, and round the armature extends a stationary soft iron magnet composed of two parts, one acting as N and the other as S, and preferably circular in form, so as to fit round the armature and economise space. The two sections of the magnet may be joined by suitable tongues projecting internally from each end of each section, and bolted through, and the magnet then wound so as to bring the two N ends together and the two S ends together, and the facings which extend nearly round the armature are then secured to the tongues, again forming N and S in themselves. It is preferred to arrange the blades of the armature alternately a little to the right and left in the direction of its longitudinal axis upon the centre boss, so as to allow of a wire being intertwined amongst the blades without extending the breadth of the armature.

3809. DIVIDING AND SUBDIVIDING THE ELECTRIC CURRENT FOR LIGHTING, *J. B. Rogers.—Dated 20th September*, 1880. 6*d*.

The idea embodied in this invention will be best understood by reference to a specific example. Fig. 1 represents a metallic disc, with central bending screw at A, and peripheral bending screw at F F F. The current from the machine coming to A divides itself equally in all

3809

FIG. 1

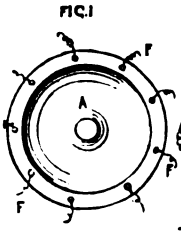
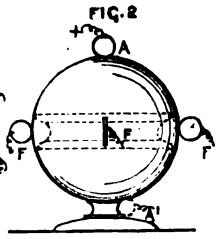


FIG. 2



directions over the disc, and is led from the binding screws F F F to the point required. In Fig. 2 the distributing apparatus is globular, the current being brought to the globe by A or A^1, and taken away at F F F as before.

3818. CONTINUOUS RAILWAY BRAKES, *G. A. C. Boothby.—Dated 21st September*, 1880. 6*d*.

This patent relates to modifications of a previous one. The bracket A on the underside of the carriage carries a drum or bobbin carrier, B, free to turn therein. This drum carries bobbin C, with soft iron cores and face plates, C^1, to which bobbins the conductors from the electric generators

3818

FIG. 1

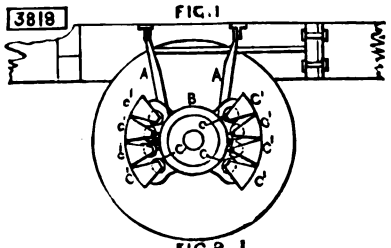
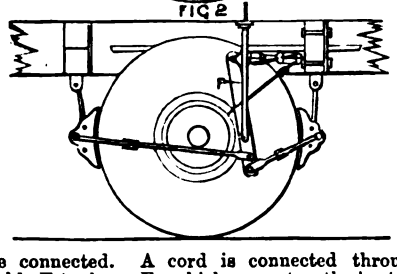


FIG 2

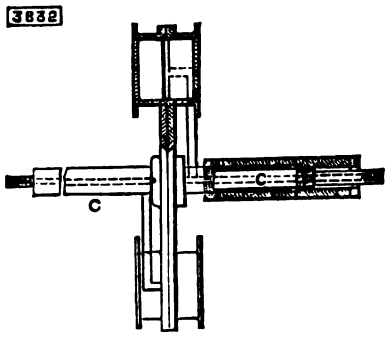


are connected. A cord is connected through tackle E to lever F, which operates the brakes. When a current is sent through the bobbin the cores become magnets, and follow the motion of the wheel, and the drum pulls upon the cord to put on the brakes.

3832. DYNAMO ELECTRIC MACHINES, *W. Elmore. Dated 22nd September*, 1880. 6*d*.

These refer to improvements in the machine described in patent No. 3565, granted in 1879. In the new machine the armature cylinder and the magnet cores are made hollow for air, water, or other refrigerating material to pass through. The commutator has been improved. On one end of main shaft is metal barrel piece C insulated from shaft, carrying on inner side standard terminals led to ends of one half of the wires of the magnets of the armature. The outer end of barrel piece

3832

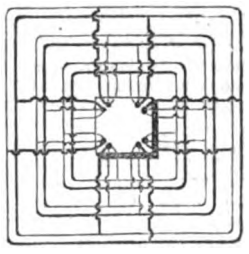


forms sections of commutator, and is provided with screw thread to engage with a nut.

3880. CONDUCTORS OF ELECTRICITY, *P. Jensen.—Dated 24th September*, 1880.—(*A communication from T. A. Edison.*) 6*d*.

This relates to the arrangement of conductors so that an equal electromotive force or pressure is maintained in all parts of the system. To accomplish this the conductors from the source

3880



have no lamps in circuit, the lamps being placed upon service circuits. The figure shows method of laying service conductors around blocks with feeding conductors from the central station.

4009. MOTIVE POWER, *J. G. Lorrain, Dated 2nd October*, 1880. (*A communication from G. Trouvé*). 6*d*.

In this machine the Siemens armature, instead of revolving concentrically to the exciter, is constructed with a core presenting polar surfaces excentric to the axis of revolution, or the surfaces

4009

of the core are concentric with the axis, while the exciter presents curved surfaces excentric to the said axis. Figs. 1, 2, and 3 show modified methods of constructing the machine.

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